OPERATIONS PLAN
FOR
ATS-F SITE EXPERIMENT

VOLUME 1
OVERALL SYSTEM OPERATIONS PLAN

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GODDARD SPACE FLIGHT CENTER, NASA
SPACE APPLICATIONS CENTER, ISRO

OPERATIONS PLAN FOR ATS-F SITE EXPERIMENT

Volume 1

OVERALL SYSTEM OPERATIONS PLAN

India U.S.

PREFACE

An operations plan defines the following:

- The functions to be performed to achieve desired objectives are defined.
- The schedules for the functions are definitized.
- Requirements of hardware and software and associated configurations are defined.
- Manpower requirements, training and documentation are defined and scheduled.
- Typical operations are defined and procedure for it described.
- Associated communications, maintenance and proper range of equipment suitable for various operations are defined.
- Tests to verify performance are described, including frequency of testing and methods to bring equipment up to standards.
- Regular preventive maintenance and calibration procedures are identified and documented.
- Organization chart defining responsibilities are included.
- Data processing and reporting methods are defined, including operational reports.
- Provisions for spares are spelled out.
- Also methods of budget tracking and control are described (internal to ISRO & GSFC).

The above methodology will be used in preparation of the SITE operations plan. For convenience, this will be consisting of six volumes.

VOL. I: OVERALL SYSTEM OPS PLAN

This is the top document. It will delineate the SITE experiment objectives, general plan and responsibilities, organization, spacecraft details, the OPS plan for four major parts of Indian ground systems namely,

(i) ESCES

(ii) The Earth Stations

(iii) Direct Reception & Rediffusion Clusters, and

(iv) Software Facilities,

and many other interface functions such as communication links within India, with Madrid, managerial and administrative liaison required between many organizations involved in the experiment, etc., Data Management plans, operational procedures, SITE operational control, ranging and many other functions related to these.

This will be brief and the main effort in this will be to identify ALL elements of the SITE experiment as a total system and provide an overview of all activities involved to bring into being an OPERATIONAL SITE EXPERIMENT.

The other five volumes will spell out the details of individual parts mentioned therein.

VOL. II: ESCES OPS PLAN

This will describe the functions and operations of the prime stations, the SITE control center, the system check out plans, communication links between ESCES and other stations, how these will be tested, maintained, etc.

VOL. III: INDIAN EARTH STATIONS OPS PLAN

This deals with Bombay, Delhi & Srinagar stations and describes the OPS plans regarding their functions in the SITE experiment.

VOL. IV: CLUSTER SUPPORT OPS PLAN

This will be in general lines of all operations plans. Its speciality requires inclusion of the following: it should include all elements such as logistics, transport, etc., required to bring into being the various clusters, maintain them and demonstrate their operations.

Also this OPS plan will define criteria for making the clusters operational and ready for SITE experiment. For the 3000 direct reception stations, tests will be identified and the methods of performing them. As for 2000 rediffusion stations, organizational and technical interfaces with various agencies to select a minimum of 2000 stations for social and technical evaluation during the SITE experiments will be spelled out.

VOL. V: SOFTWARE OPS PLANS

Will describe as to how the software scheduling and delivery will be done for various tests and demonstration phases and also the regular scheduled broadcasts. The stocks buildup at Ahmedabad, delivery to back-up stations, signal delivery from studio to earth stations, reception of signals from earth stations, etc., will be discussed.

VOL. VI: SITE OPERATIONAL INTERFACE DOCUMENT

This describes the many interfaces during the operation of the SITE experiment. To name a few are the interfaces with ATSOCC & Madrid, interfaces between studios and earth stations, the provision for communication links and tests for the same, dedicated telephone lines and tests for their operational readiness, etc. Note that the Volumes II, III, IV, & V will deal with some of these in great detail, e.g., ESCES-Madrid link operational tests will be described in Vol. II. Still this interface document will tie many loose ends of the SITE systems operations and whenever details of the interfaces exist elsewhere they will be referred to. The primary purpose of this document is to identify ALL interfaces and keep track of their operational integrity.

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SITE OPS PLAN

1.0 PURPOSE

This is the top document that delineates the SITE experiment objectives, and defines plans and organization to achieve them. It encompasses the total system required to bring into being operational SITE experiment and the companion volumes to this will elaborate in detail the plans described herein.

2.0 INTRODUCTION

2.1 INDIA/U.S. AGREEMENT

On 18 September, 1969, the Department of Atomic Energy (DAE) of India and NASA signed a Memorandum of Understanding in which the parties have agreed to employ ATS-F for an Indian Domestic TV broadcast experiment.

2.2 EXPERIMENT OBJECTIVES

The following are the experiment objectives excerpted from the Memorandum of Understanding:

GENERAL OBJECTIVES

The general objectives of the experiment will be to:

- Gain experience in the development, testing and management of a Satellite-based instructional television system particularly in rural areas and to determine optimal system parameters.
- Demonstrate the potential value of satellite technology in the rapid development of effective mass communications in developing countries.
- Demonstrate the potential value of satellite broadcast TV in the practical instruction of village inhabitants.
- Stimulate national development in India, with important managerial, economic, technological and social implications.

Secondary Objectives

- Contribute to general school and adult education.
- Contribute to teacher training.
- Improve health and hygiene.

Indian Technical Objectives

- Provide a system test of broadcast satellite TV for national development.
- Enhance capability in the design, manufacture, deployment, installation, operation, movement and maintenance of village TV receivers.
- Gain experience in the design, manufacture, installation, operation, movement and maintenance of broadcast and/or distribution facilities to the extent that these are used in the experiment.
- Gain an opportunity to determine optimum receiver density, distribution, and scheduling, techniques of audience attraction and organization, and to solve problems involved in developing, preparing, presenting and transmitting TV program material.

United States Technical Objectives

- Test the design and functioning of an efficient, medium-power, wide band space-borne FM transmitter, operating in the 800-900 MHz band and gain experience on the utility of this space application.

2.3 GENERAL EXPERIMENT PLAN AND RESPONSIBILITIES

The following is excerpted from the Memorandum of Understanding:

Following initial NASA experimentation with ATS-F, NASA would use its best efforts to position the satellite within view of India as early as possible to permit its use for the duration of this experiment. NASA will maintain control of the satellite while the use of the satellite for the ITV experiment will be under the exclusive control of India. The appropriate authorities of the Government of India shall be solely responsible for the coordination of radio frequencies, earth to satellite and satellite to earth, insofar as this experiment, India and the surrounding region are concerned, in the frame-work of frequency coordination established in the International Telecommunications Union.

It is understood by DAE and NASA that the space segment responsibilities of NASA under this agreement do not go beyond the provision of experiment time on the satellite for approximately one year; no continuing responsibility is implied.

The DAE will arrange for the transmission of instructional TV programs from its earth station at Ahmedabad to the Satellite for broadcast to appropriate receivers provided and sited by Indian agencies in villages in India. The number

of receivers contemplated is approximately 5,000, to be widely distributed. The actual figure may, however, be less depending upon experience with ground terminal costs. Responsibility for the TV programming is entirely with India and the use of the satellite would be in conformity with the specific objectives. The Government of India shall be solely responsible with respect to any legal proceedings which may be brought regarding such TV programs, and shall hold the Government of the United States harmless therefrom.

The DAE and NASA recognize the possibility of utilizing the Ahmedabad earth station for monitoring the performance of the experimental satellite and for its stationkeeping, and the DAE agrees to make this facility available to NASA for this purpose and further agrees to make available to NASA any data received from the satellite. While the DAE would not charge NASA for such use of the Ahmedabad earth station, costs incurred in making data available, such as the costs of purchase and transportation of tapes, would be met by NASA. The DAE and NASA also recognize the possibility of utilizing the Ahmedabad earth station for the purpose of conducting NASA-programmed scientific and technological experiments. These would be conducted on a time available basis and as mutually agreed.

Respective Scientific Responsibilities

The DAE will use its best efforts to:

- Develop, provide and maintain in service the ground segment of the TV satellite experiment system that will carry out the technical objectives of the experiment.

- Develop and utilize ITV program materials that will carry out the instructional objectives of the experiment.

- Develop and implement a mutually acceptable experiment evaluation plan.

- Prepare and publish interim progress reports at six-month intervals and a final report within 18 months of the end of Phase III. (See explanation of phase below.)

- Make available trainees for such training as may be agreed to between Program Managers.

- Receive, record, reduce and analyze such ancillary engineering data as may be agreed between Program Managers.

NASA will use its best efforts to:

- Place into geostationary orbit an experimental Applications Technology Satellite (ATS-F), position it within view of India after a period of time, to be determined by NASA, but no greater than one year, and maintain it on station for approximately one year. The time required of the ITV experiment, which is hoped to be about six hours a day, will be made available for the experiment during this period as NASA continues its own experimental effort using the satellite. It is recognized that in practice, power limitations in the satellite may require a reduction in the time available to approximately four hours.

- Provide to the DAE such training and consultative services as may be agreed to between Program Managers.

2.3.1 Fulfillment of Responsibilities

Fulfilling the above responsibilities involves coordination with other departments, organizations, and agencies in India such as All India Radio, and State Governments. This will be done by ISRO.

2.4 PHASING OF THE EXPERIMENT

Phase I: India will undertake necessary improvements to the earth station at Ahmedabad. Research and development will continue on the design, prototyping, manufacture and testing of ground segment components. The Indian technicians involved will become familiar, to the extent necessary, with space segment characteristics. NASA will supply technical assistance and advice during this phase as agreed to between Program Managers.

Phase II: Phase I activities (which include the Delhi experiment) will continue and intensify. This would provide new centers of expertise, uncover and solve operational problems, permit experiments with different approaches, and develop a cadre of personnel for the next phase in receiver deployment and maintenance and in programming.

Phase III: The parties will conduct an instructional TV experiment using the ATS-F satellite.

2.5 ORGANIZATION

2.5.1 Program Managers

For DAE

Prof. E. V. Chitnis
Indian Space Research Organization
Physical Research Laboratory
Navrangpura
Ahmedabad-15, India

For NASA

Dr. A. M. Greg Andrus
NASA Headquarters
Washington, D.C. 20546, U.S.A.

2.5.2 Project Manager

For DAE

Dr. B. S. Rao
Indian Space Research Organization
Electronics System Division
Ground Floor, Barrack No. 1
Polytechnic Post Office
Ahmedabad-15, India

For NASA

Mr. Anthony Sabelhaus
Code 460
Goddard Space Flight Center
Greenbelt, Maryland 20771, U.S.A.

2.5.3 Principal Investigators

For DAE

TBD

For NASA

Mr. John E. Miller
Code 751
Goddard Space Flight Center
Greenbelt, Maryland 20771, U.S.A.

2.5.4 Operations Managers

For ISRO

TBD

For NASA

Mr. E. E. Metzger
ATS Mission Operations Manager
Code 460
Goddard Space Flight Center
Greenbelt, Maryland 20771, U.S.A.

2.6 EXPERIMENT DESCRIPTION

Reference is made to block diagram, Figure 2-1.

Approximately twelve months after ATS-F launch, the spacecraft (s/c) will be positioned at 35° E so that it is within the view of India. ATSOCC will perform the command control and telemetry monitoring functions of the s/c through the Hybrid Terminal to be located at some convenient location within the sight of the s/c (probably at Madrid). Orbit determination will be derived from range and range rate (RARR) measurements conducted by the Hybrid, by ESCES in Ahmedabad, India using NASA furnished equipment and by possibly a third ground terminal at one other location.

India plans to originate its TV programs from one of at least three locations (Ahmedabad, Bombay and Delhi) and irradiate the s/c at C-band with a frequency modulated carrier. The s/c will receive this up-link signal on the earth coverage horn (ECH) and transpond it to 860 MHz which is beamed back to India by the s/c 30 ft antenna. Three thousand (3,000) TV receivers, with front end attachments, at various locations within India will utilize the UHF signal directly. In selected areas, such as Bombay-Poona, Ahmedabad, (Anand area), Delhi and the Valley of Kashmir, the UHF signal, after down-link reception and baseband detection, will be transmitted over conventional VHF for rediffusion to an additional two thousand (2,000) conventional TV receivers. Cross-strapping within

the s/c to C-band downlink using the ECH will permit monitoring by the Hybrid, which because of the geographic location is out of the field of view (FOV) of s/c UHF beam.

India employs monochrome TV using 625 lines, 50 fields/sec interlaced 2 to 1. This video signal is accompanied by two audio channels, one at 5.5 MHz and the other at 6 MHz enabling each receiving earth station and each augmented TV receiver a choice of one of the two languages being broadcast. There are 15 officially recognized languages. Programs will be scheduled for approximately four hours per day.

3.0 SYSTEM DESCRIPTION

The SITE system basically comprised of the ATS-F spacecraft (s/c) positioned in view of India and the Indian ground system consisting of the prime station ESCES, other back-up earth stations, rediffusion transmitters, clusters containing community TV reception centers, software generation studios and links between these. ATSOCC controls the spacecraft through transportable ground stations and these will have communication links to the SITE control center situated at ESCES, Ahmedabad.

First the spacecraft will be described, then NASA operations and the Indian Ground System (IGS).

3.1 SPACECRAFT

ATS-F is a three axes stabilized spacecraft capable of generating about 500 watts of dc power from solar array. The attitude control subsystem provides the necessary attitude stability and accurate slew control required in order to perform the many on board experiments. It uses the radiant energy from the earth and the star polaris as its primary attitude sensor references. A list of redundant sensors and torquers include analog and digital sun sensors, two 3 axis rate gyro packages, an earth sensor, two polaris trackers, a monopulse attitude error sensor, an interferometer, three orthogonal reaction wheels, and two redundant hydrazine propulsion systems.

3.1.1 Spacecraft Communication Subsystem (CSS)

This is one major subsystem of the spacecraft and it is shown in Figure 3-1. There are many modes available. The SITE experiment uses the C-band receive-to-UHF transmit mode. The antenna for reception is the Earth Coverage Horn (ECH) and transmit is through UHF feed-elements illuminating the deployed 30 ft

dish. The portions of ATS-F Communication Subsystem used for the SITE are shown by asterisks in the Figure 3-1. The characteristics are summarized in Table 3-1.

The SITE television signal is originated from India at one of the three C-band frequencies 5950, 6150, or 6350 MHz. The signal transmitted to the spacecraft is frequency modulated by a composite video audio baseband signal formatted to CCIR standard B with an added sound carrier located at 6 MHz. The modulation index is such as to fill nominally 25 MHz quality bandwidth of the spacecraft transponder with the transmitted spectrum.

The uplink signal enters the transponder via the receive earth coverage horn (ECH) is amplified by one of the two (redundant) tunnel diode amplifiers and down converted to IF at 150 MHz. For SITE, the spacecraft is configured in the frequency translation (FT) mode in which the local oscillator inputs to the down converters and C-band upconverter are derived from one of the two (redundant) frequency synthesizers controlled by onboard highly stable crystal oscillators. The UHF upconverters utilize separate crystal oscillators.

At the IF, the signal is amplified, filtered to a 40 MHz noise bandwidth and limited, by any of the three (redundant) IF amplifiers. An AGC loop prior to the limiter further stabilizes the overall IF output level. The IF output signal is then converted to the UHF frequency of 860 MHz, amplified and beamed back to India via the UHF feed and 30-foot dish.

Since the Hybrid terminal is located outside India, it will be beyond the field of view of 2.8° of the UHF beam. So for monitoring purposes, a cross-strap to the C-band transmitter is provided to illuminate the Hybrid via the down link ECH. The C-band transmitter is configured for full power using two parallel travelling wave tube amplifiers or with either one feeding the C-band feed at a lower power, at about half of the two tube operation.

All the transponder switching functions are controlled and monitored by the Hybrid terminal through the spacecraft telemetry and command subsystem.

3.1.2 Other Spacecraft Subsystems

Needless to say, a normally operating spacecraft is needed to receive signal, point the UHF beam to right location India and remain stable there, generate the needed radiated power and so on. Thus all subsystems of the spacecraft need to be functioning well. Still herein some systems like Telemetry and Command Systems (T&CS), Power Subsystem and major attitude control sensors are described.

Table 3-2 summarizes T&CS

Table 3-3 summarizes Power Subsystem

Table 3-4 summarizes major attitude control system parameters.

Figure 3-2 describes the predicted solar array power delivery characteristics and the requirements of the SITE experiment.

3.2 NASA OPERATIONS

After about one year of conduction of various experiments like PLACE, HET, RFI, TDRE, etc., over the U.S. after launch, the spacecraft will be moved towards India and will be stationed at 35°E in about 5 weeks. ATSOCC will control all the operations, and will do it through the Hybrid Terminal when the s/c is located at 35°E.

3.2.1 ATSOCC

All operations with the ATS spacecraft are controlled by the ATS Operations Control Center (ATSOCC). ATSOCC coordinates all experimenter requirements and schedules the spacecraft operations and the activities of the participating ground stations. ATSOCC will maintain real-time voice contact with participating stations and monitor the status of the spacecraft through the use of data from the ATS stations.

ATSOCC will also coordinate all activities between the various elements of GSFC such as data processing and orbit determination and will provide daily, weekly, and monthly summary reports of all operational activities. Logs, data sheets, and plots will be kept of selected parameters and activities. Displays of spacecraft/ground station status will be maintained. ATSOCC will also keep account of all data to and from the ground stations.

3.2.2 U.S. Ground Stations

The ATS-F spacecraft will be supported from three locations during the first year of operation. These are:

1. Rosman, North Carolina
2. Mojave, near Barstow, California, and
3. Santiago, Chile

The spacecraft subsatellite point will be 94°W longitude during this period.

A Hybrid Terminal will be configured at Mojave from parts of the Transportable Ground Station (TGS) and the ATS Mobile Terminal. It will be used at Mojave for training as well as mission purposes for the first six months after launch of ATS-F, and then deployed to Madrid.

Rosman, Mojave, and the Hybrid will accommodate ATS-F frequency, T&C, and ADP requirements, while retaining compatibility with previous ATS spacecraft (ATS-1, ATS-3, and ATS-5). In addition, the Hybrid will contain UHF equipment to support the TRUST and SITE experiments. Santiago will support the T&DRE and PLACE experiments by providing antennas (obtained from the TGS) and ancillary equipment for the experimenters to use in conjunction with their respective simulators. Rosman, Mojave, and the Hybrid have nearly identical communication equipment and all have the same basic capability with regard to performance and evaluation of spacecraft data.

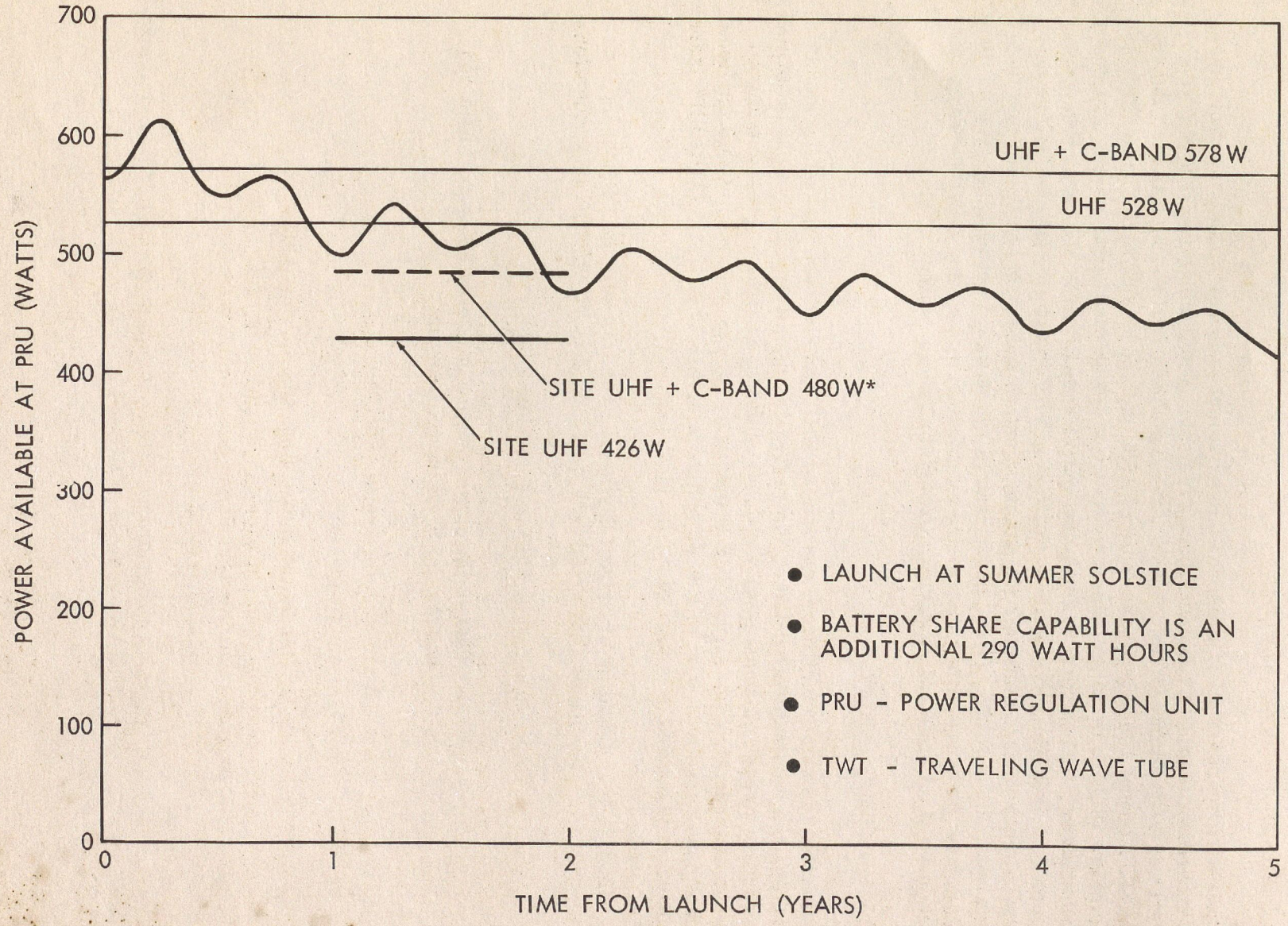
3.2.3 Hybrid Station

This will be situated at Madrid, Spain. All the spacecraft operations such as switching of transponders, orientation of s/c, etc., are controlled and monitored by the Hybrid through the s/c T&CS. This is a self contained 21 ft terminal for transmission and reception at C-band as well as S & L bands. It is completely equipped for command and control of the s/c as well as reception and processing of the s/c telemetry. RARR is also installed in the Hybrid.

3.2.4 NASA Communication Links

The NASCOM system furnishes all NASA mission control and computation centers with access to the remote tracking, data acquisition, and command stations. The system supports all NASA projects by providing communications circuitry routed through the primary NASCOM switching center at the Goddard Space Flight Center (GSFC), Greenbelt, Maryland, and the remote NASCOM switching centers at Canberra, Australia; Honolulu, Hawaii; London, England; and Madrid, Spain.

The NASCOM Network is composed of approximately 200 terminal stations linked by approximately three million circuit miles of voice, low-speed data (teletype), high-speed data, and wideband data communications circuits. A real-time computer switching system employs UNIVAC 494 (at GSFC) and UNIVAC 418 computers at NASCOM switching centers (Canberra and Madrid) to provide automatic message switching within the network.



*ONE TWT

Figure 3-2. Solar Array Capabilities

3.3 INDIAN GROUND SYSTEM

The Indian responsibility in the SITE experiment is to establish the ground system needed in India to conduct the experiment. The Indian Ground System consists of (i) the Prime Uplink Station ESCES at Ahmedabad, which is also the seat of SITE control center, (ii) the Indian Earth Stations (IES) which are located at Bombay, Delhi & Srinagar, the former two of which also serve as back-up uplink stations, (iii) the direct reception and VHF rediffusion clusters, (iv) software generation facilities, (v) various rediffusion VHF transmit stations, including limited rebroadcast stations, (vi) communication links between these, and those between India & NASA, (vii) Nagpur station which would act as a back-up aid to spacecraft pointing (either monopulse or interferometer) and (viii) various maintenance and administrative centers to sustain the operational system.

3.3.1 Indian Ground Stations

Excepting the studio facilities, associated VHF transmitters, all maintenance centers and communication links, the rest of the Indian Ground System is termed the Indian Ground Stations as they either receive spacecraft signal or transmit to the spacecraft. The Anand VHF transmitter for the purposes of this top document considered as a part of ESCES and regular All India Radio (AIR) VHF transmitters are treated as a part of studio facilities.

3.3.1.1 Location of Ground Stations. The following is a list of the stations that would be used in the experiment and their functions:

A. Ahmedabad 72°40'E 23°00N

- This is the Prime Station for the SITE experiment and houses the SITE control center
- Transmits to s/c at C-band

  TV Programs

  Range and Range Rate (RARR) Signals

  Special Data Link signals
- Receives from s/c

  TV programs at UHF originated by other Indian stations
  RARR signals at C-band

  Special data link signals at C-band

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Foreword

By the very nature of the problems, resources and infrastructure of India the application of high technology to the solution of important practical problems is different for India than for the more advanced countries. The development strategy adopted, the paths followed for creating the expertise required and the organizational integration required from different segments of the economy to realize practical benefits are different, difficult and require solutions that are specific to India. The Indian experience in remote sensing clearly demonstrates this difference.

By the time this publication is produced, India will have gone through about 15 years of experimentation with modern techniques of remote sensing using data from satellites and aircraft. This phase for India not only included using data from the satellites of other countries but also a phase of building, launching and operating her own satellites. The unique feature of the Indian experience has been the large-scale involvement of a whole host of user agencies from the very beginnings of the programme. Many of these agencies had a strong background in resources management and in the interpretation and analysis of aerial photos. Through a series of joint experiments by the two main agencies dealing with the supply of raw remotely sensed data—the Indian Space Research Organization (ISRO) and the National Remote Sensing Agency (NRSA)—these users have reached a level of maturity and competence that makes large-scale practical application realizable in the near future.

The other elements of the Indian experience that are worth emphasizing relate to the basic Indian objective of developing capabilities not only in the use of remote-sensing data but in building the satellites, the sensors that provide the data and the ground systems. This approach strives to integrate the national space programme objectives with the practical requirements of resources management which encompasses a whole range of organizations. Recent developments on this front include the setting up of an interministrial mechanism for the evolution of a National Natural Resources Management System (NNRMS). The articles in this issue are selected from a Seminar specially held in May 1983 to take stock of the Indian experience in remote sensing and make recommendations on the path that India should follow to realize its objectives of using space technology for the realization of practical benefits. While pursuing the benefits of this technology, it is well understood that it is not a panacea and at best could serve as an important component in the development of the country.

The first paper on the Indian experience with a remote-sensing system will give the reader a quick review of the experience with the Indian Earth Observation Satellites—Bhaskara series—and the technologies that go into the Indian Remote Sensing Satellites—IRS. It gives some idea of the series that is likely to follow. The IRS series will form the core of the NNRMS.

Then follow a series of papers on applications—stressing the end results. Many of the applications experiments have depended on visual interpretation of LANDSAT imagery, air photos, aircraft multispectral scanner data and a fairly large amount of ground information. In a few cases advanced machine processing and interactive techniques have been used. Some of these experiments may not be

exciting in terms of a particular interpretation technique; but the search for an (Indian) optimal integration of multitier surveys is the common thread in all of them.

Finally, there is a paper attempting to give an overview of the direction in which the thrust for remote-sensing applications will be in the IRS timeframe (1983–1987).

A couple of papers such as the joint experiments to identify marine fish resources and the assessment of water stress on crops give an idea of some advanced applications research efforts in the country.

One always feels inadequate in dealing with such a vast spectrum of activities, especially while attempting to give a picture of the modernization process that is taking place through scientific papers without losing too much scientific rigour. We hope that the selection of papers has met this goal. It was not possible to highlight many aspects of international co-operation which has been an important element, right from the early days. Valuable suggestions and scientific criticism from the international community will definitely help the Indian systems. This purpose will be served if the articles in this issue provide the readers with a flavour of the Indian experience.

Modern remote-sensing techniques in India owe their origin to the late Dr. Vikram Sarabhai, the founder of the Indian Space Programme and Prof. P. R. Pisharoty, who conducted the early experiments in ISRO.

Prof. Yash Pal, who was Director of the Space Applications Centre of ISRO since 1972 and is now with the Indian Planning Commission, is the originator of the idea of such an issue in the *International Journal of Remote Sensing* along with Prof. A. P. Cracknell. Prof. Yash Pal was the friend, philosopher and guide in the selection of the articles and in giving shape to the issue.

Special mention should be made of Prof. S. Dhawan, Chairman of the Indian Space Research Organization and Secretary, Department of Space, who was the originator of the idea of NNRMS and is the constant force behind its evolution and also of Prof. M. G. K. Menon, Member Planning Commission and Chairman of the Planning Committee of NNRMS. Without constant co-operation from many organizations and their scientists this issue would not have been possible. We are grateful to the authors who have co-operated in rewriting the papers at very short notice.

Special thanks are due to those who helped through their evaluation, advice and criticism, especially to Dr. K. Kasturirangan, Dr. V. R. Rao, Mr. K. Krishnan Unni, Maj. Gen. G. C. Agarwal, Maj. Harnek Singh, Prof. B. L. Deekshatula, Mr. A. S. Ramamoorthy, Dr. Baldev Sahai and Mr. D. S. Kamat.

The tireless and constant perseverance of Dr. V. R. Rao and Ms. G. Vijayalakshmi, ISRO Headquarters, has made the evolution of the NNRMS, the conduct of the National Seminar and the bringing out of the *International Journal of Remote Sensing* papers possible.

Y. S. Rajan
Scientific Secretary
ISRO Headquarters
Cauvery Bhavan F-Block
Kempegowda Road
Bangalore 560 009
India

- Rebroadcasts VHF TV to 500 VHF receivers in the Anand area

B. Bombay 72°54'E 19°30'N

- Transmits to s/c at C-band

  TV programs

  Special data link signals

- Receives from s/c

  TV programs at UHF originated from the other stations

  Special data link signals at C-band

  Rebroadcasts VHF TV to 500 VHF receivers in the Bombay-Poona region

C. Delhi 77°12'E 28°38'N

- Transmits to s/c at C-band

  TV programs

  Special data link signals

- Receives from s/c

  TV programs at UHF originated from the other stations

  Special data link signals at C-band

- Rebroadcasts VHF TV to 500 VHF receivers in the Delhi region

D. Srinagar 74°51'E 34°06'N

- Receives TV programs from the s/c at UHF

- Rebroadcasts VHF TV to 1000 VHF receivers in the Valley of the Kashmir

E. Direct Reception UHF Community Receivers (Different Parts of India)

TV Receivers (500 each) located in the following areas:

Madras
Calcutta
Rajasthan
Madhya Pradesh/Orissa
Bihar
Uttar Pradesh

F. Limited Rebroadcast Stations (Located in different parts of India)

During the SITE it is planned to have limited rebroadcast stations wherein 50w to 100w VHF TV transmitters would broadcast signals received from the satellite to nearby areas. The exact locations and the number of such units will be decided later.

G. Nagpur 79°30'E 21°00N

This will contain any or all of the following transmit systems:

- C-band (6 GHz) transmitters and antennas to provide a signal for interferometer
- S-band and VHF transmitters and antennas for providing signals to spacecraft monopulse system

This station is essentially to provide a back-up mode to enable the spacecraft to point to the center of India in case of any malfunctions in the spacecraft ACS subsystem.

3.3.1.2 Ground Station Descriptions. Table 3-5 summarizes the principal characteristics of the ground stations.

3.3.1.2.1 Ahmedabad (ESCES-ISRO)—This is an existing experimental facility equipped with a 14 meter (46 ft) azimuth over elevation, Cassegrain parabolic antenna for C-band transmission and reception (having rotatable orthogonal linear polarizations for transmit-receive). Some modifications will be done to the

existing facility to suit the needs of the SITE experiment. A new 30 ft parabolic reflector antenna will be installed to receive 860 MHz (and 2.5 GHz) from the ATS-F; this will have X-Y mount and limited manual steering.

ESCES houses the SITE control center and studio facilities to transmit TV to the satellite.

An ATS-R equipment from NASA will be installed here for ranging purposes.

Signals received from satellite through 30 ft disk will be rebroadcast to ANAND area; VHF transmitter for this will be located near ANAND and a microwave link will connect ANAND and ESCES.

3.3.1.2.2 Bombay (ISRO) Earth Station—This terminal is in the planning stages and its exact location is yet to be finalized. It will be a 30 ft transportable terminal providing the same capability as ESCES for both C-band and UHF. This will not have any ranging capability. The TV signals received through this terminal from the satellite will be connected to AIR's Bombay VHF transmitter for rebroadcast and also to Poona region through microwave links.

3.3.1.2.3 Delhi (ISRO)—This will be located near Delhi and will be a duplicate of the Bombay station. It will be connected to Delhi AIR TV station through microwave links.

3.3.1.2.4 Srinagar (ISRO)—This is a 35 ft parabolic mesh antenna for UHF receive only facility. Rebroadcast will be done to the Valley of Kashmir by connecting the satellite signals received through this to regional AIR VHF stations.

3.3.1.2.5 Direct Reception Clusters (DRC)—These clusters will be located at different selected locations throughout India, each cluster containing about 500 direct reception stations (DRS). (See Figure 3-2a, Map of India.) The UHF FM TV signals from the satellite will be received at each of the DRS through a 10-ft chicken mesh antenna. After FM discrimination of the composite video-audio signal, the signal is conditioned appropriately to be connected to video portions of a conventional TV receiver; the desired audio portion can be selected through a switch at the receivers.

3.3.1.2.6 Rediffusion Reception Clusters (RRC)—These differ from the DRC in that they do not receive UHF signals; they are just conventional TV receivers, receiving signals from the VHF rebroadcast stations. As many in Bombay, Delhi, Poona, and Srinagar who receive regular VHF TV broadcasts from AIR, also receive these satellite-based-rebroadcast-programs, definite clusters and receiver sets will be identified by ISRO for the SITE experiment technical and social evaluation. The language capability at the receiving sets is limited to one as decided by the local VHF transmitting station.

3.3.1.2.7 Limited Rebroadcast Stations (LRS)—These will be made of solid state transmitters (VHF) producing about 50w to 100w for rebroadcasting the satellite derived signal through VHF to limited areas. The exact locations and the number of such stations are not yet finalized.

3.3.1.2.8 Nagpur Station—This will contain any or all of the following transmit systems:

- C-band (6 GHz) transmitters and antennas to provide a signal for interferometer
- S-band and VHF transmitters and antennas for providing signals to spacecraft monopulse system

This station is essentially to provide a back-up mode to enable the spacecraft to point to the center of India in case of any malfunctions in the spacecraft ACS subsystem.

3.3.2 Software Generation Facilities

By the term software we mean all the program materials such as films, videotapes, tape recorders, etc. They will be produced in many laboratories and studios in many parts of India. For the purposes of SITE we define Software Generation Facility as the one which sends video signals to the Earth Station and Prime Station.

3.3.2.1 Location. The Software Generation Facilities or studios for the SITE are located in the following areas viz., Ahmedabad, Bombay, Delhi.

3.3.2.2.1 Studio Description—The technical details of the studios are given in Table 3-6.

3.3.2.2.2 Ahmedabad Studio—This studio is the one attached to the Prime Station, ESCES. This will be connected to ESCES by cables or microwave links. All the scheduled broadcast tapes or films will be stored here; the software stock here will be for approximately 15 days of scheduled broadcast. Technical description of this will be given in Table 3-6.

3.3.2.2.3 Bombay Studio—This is the regular All India Radio (AIR) Station which broadcasts regularly to Metropolitan Bombay and vicinity. During SITE, as decided by the SITE control center, at Ahmedabad, this station will be connected to the Bombay Earth Station for transmission of video signals. This will store back-up program materials for the SITE. For technical details see Table 3-6.

3.3.2.2.4 Delhi Studio—Similar to Bombay Studio, this is a regular AIR station and its role is the same as Bombay Studio — it is a back-up to the SITE experiment, and will be connected to the Delhi Earth Station as decided by the SITE control center. For technical details see Table 3-6.

3.3.3 Maintenance and Evaulation Facilities

One very important technical and operational aspect of the SITE experiment is to maintain the community TV receivers (both direct reception sets and VHF rediffusion sets) in good working condition. This is very important for technical or social evaluation of the experiment. Besides, the problems that are found and solutions that are arrived at, for maintaining such sets in isolated village communities, would go a long way in deployment of future national coverage system in India. The maintenance aspect covers also the power supplies for TV sets.

The evaluation work during SITE is both technical and social. Details of social evaluation plan are discussed elsewhere in this plan. Presently it will discuss the technical (engineering) aspects of maintenance.

3.3.3.1 Direct Reception Clusters. The Direct Reception Clusters (DRC) are spread out in about seven different regions of India. The villages in these clusters will be separated by few miles; some of them may have good roads and electricity and some may not have these. In order to maintain an operational SITE experiment, it is mandatory that most of these TV sets are working in good condition during any given time. Hence periodic preventive maintenance checks by skilled technicians and also attendance to immediate repairs are needed. It may also be needed to teach

the villagers some simple operations, such as turning on TV sets at scheduled times, turning off, and probably volume controls, antenna tweeking, etc. There could be many day to day problems of component failure in electronics, natural calamities, such as high winds blowing out antennas, etc. In such cases information and organization systems have to be developed to contact the right place, and speedy dispatch of people trained to do the job to problem areas, repairing the defects and so on. Besides, everyday when the spacecraft is acquiring some feed back about the quality of the signal in the clusters, etc., signals are to be fed back to the Prime Station and/or the then transmitting Earth Stations from Special Validation Clusters which will be formed of about 15 stations per each cluster. This whole range of operations involve detailed technical planning and skilled management. Detailed modus operandi will be discussed in Cluster Support OPS Plan.

3.3.3.2 Rediffusion Reception Clusters. For VHF rediffusion, the satellite derived TV signal will be connected to the local AIR (VHF) TV stations. These stations regularly serve hundreds of TV sets owned by individual homes in India, and many community sets managed by local organizations, agencies and State Governments. During the SITE these AIR stations which have one operating channel will be tied to the satellite derived TV programs. For the purposes of SITE evaluation, ISRO will identify at least 2000 community VHF TV sets located at different places in India, out of the many TV sets served by AIR. These will be part of the SITE experiment. The exact details of maintenance and evaluation plans will depend upon the arrangement and commitments agreed upon between ISRO and concerned Indian bodies/ agencies.

3.3.3.3 Limited Rebroadcast Stations. These include both the low power VHF transmitting stations (about 100 watts), equipment to derive satellite signals such as antennas, front-end converter, etc., power supplies for transmitters, towers for antennas and also the VHF TV sets that will be served by them. Most of the TV receiving sets served by these may be installed and maintained as also the TV transmitters. Again maintenance and evaluation of the operation of these will be addressed in detail in Cluster Support OPS Plan.

3.3.4 Communication Facilities

Communication links between various elements of the SITE experiment and their timely and healthy operation is vital to maintain an operational SITE experiment.

3.3.4.1 Communication Links to NASA. During the SITE experiment GSFC/NASA will be in control of the satellite. Thus ATSOCC is the main control center for the satellite. For operations at 35°E (i.e., for experiments over Europe and the SITE over India) Madrid station will act as the command terminal for ATSOCC. It is with this Madrid Hybrid terminal, the SITE control center located at ESCES, Ahmedabad will keep continuous communication during the experiment. The links will be both voice lines and TTY links both set up to NASCOM standards.

3.3.4.2 Internal Communications in India. Meeting points for communications between NASA and ISRO during the SITE experiments are Hybrid terminal at Madrid and the ESCES at Ahmedabad. All the information to Madrid station from NASA stations flow through NASA communication links described in paragraph 3.2.4. All the information needed for the SITE experiment in India come to the SITE control center at ESCES wherein the action is taken — either as instruction to Indian subsystems or communication to NASA. Thus the Indian communication links form the nerves of SITE experiments to keep the SITE control center effective.

3.3.4.2.1 Links Between Uplink Stations—Ahmedabad ESCES station is the prime station for uplink transmission during the SITE experiments. In case of problems in transmission the SITE control center requests the Bombay or Delhi station to do the function. In order to make a decision for such a transfer, it needs constant information regarding their status, and also it should be able to inform Bombay or Delhi stations to be ready, instruct them on the programs to be broadcast and so on. This will be done with telephone lines and telex lines. The exact agreements regarding the lines, the number of them, the lease status, their maintenance and checks, will be done by ISRO with other agencies involved. Such details will be discussed elsewhere in this document under paragraph 4.6.13 (part of operational interface document). These links have to be on all the time for the experiment.

3.3.4.2.2 Links to Rebroadcast Stations—Rebroadcast stations are regular AIR stations in Bombay, Delhi and Srinagar; in Ahmedabad it will be built by ESCES. For the receive only stations such as

Srinagar only information link needed is regarding the stations of their readiness and the quality of signal received from the satellite. These receive only broadcast stations should have such links (either as teletype or voice links) to all the three uplink stations — Ahmedabad, Bombay and Delhi either directly or indirectly. Receive-transmit type of rebroadcast stations such as Delhi-AIR-Station which is connected to Delhi Earth station should have a microwave link (or coaxial) to connect the Earth station to the studio of the rebroadcast station, both to receive the satellite derived signal through the Earth stations and also to send TV signals to the Earth station in case it is sending the uplink to the satellite. For Delhi, Bombay and ESCES such links are microwave links. These links too should be available all the time during the experiment.

3.3.4.2.3 Links to Special Validation Clusters—Before the regular broadcasts for SITE experiment starts and also daily before starting of broadcasts, it is necessary to assess the signal quality of the receiving sets. As it is impractical to test all the 5000 TV sets, special validation clusters, each having about 15 TV sets, will be identified to represent the group of clusters. These will have links to the SITE control center to inform about their signal quality. Details as to whether these should be telex lines, telegraphic lines or telephone lines are to be worked out.

3.3.4.2.4 Links to Studios—In case the VHF rebroadcast transmitters are not located near the studios that feed them the TV program material, the links for the same have to be provided. These will be firmed up after site selection for Earth stations, VHF transmitters and studios.

3.3.4.2.5 Other Interface Links—It should be noted that the various elements for SITE experiments in management and administrative sense are spread in various agencies in India. Hence good communication links — telex, telegraph, mailing and telephone links — between many such agencies and offices is an important aspect to which attention should be given. For example, links between AIR & Space Application Center (SAC), ISRO, Ahmedabad; links between various State Government agencies that provide the VHF rediffusion TV receiving stations and SAC, etc., are to be accounted for in total operations. This would avoid surprises at a later date.

4.0 ORGANIZATION OF OPERATIONS PLAN

The operations plans for the SITE experiment consist of six volumes, viz.:

I. OVERALL SYSTEM OPERATIONS PLAN

II. ESCES OPERATIONS PLAN

III. INDIAN EARTH STATIONS OPERATIONS PLAN

IV. CLUSTER SUPPORT OPERATIONS PLAN

V. SOFTWARE OPERATIONS PLAN

VI. OPERATIONAL INTERFACE DOCUMENT

An overview of the functions of each operations plan is described in the Preface to this document.

4.1 OVERALL SYSTEM OPERATIONS PLAN

This volume (Vol. I) is the Overall System Operations Plan; it overviews all the operations involved in bringing forth an operational SITE experiment. As the table of contents of this document (being read) describes all the details that are covered in this document, no further description is needed here in this paragraph.

4.2 ESCES OPERATIONS PLAN

This describes all activities that will be done at the prime station, ESCES, Ahmedabad, for the SITE experiment.

4.2.1 Functions

ESCES is the Prime Uplink Station for the SITE experiment. It houses the SITE control center and this will be the control center for all operations during the SITE experiment. ESCES also contains the ATS-R ranging equipment and thus provides the ranging information at periods that will be agreed upon between ISRO and NASA. Also ESCES is the contact point for all NASA communication links to India.

4.2.2 Organization Chart

See Figure 4-1 which describes the Organization Chart of ESCES as related to the SITE experiment, listing key people.

4.2.3 Schedules

Detailed milestone charts showing all important development and operational activities done by ESCES for the SITE experiment are shown in Figure 4-2. The activities such as completion of test plans, reviews, etc., also are shown on these milestone charts.

4.2.4 Manpower Requirements

The manpower involved at ESCES for the SITE experiment both for development and operations is shown on Table 4-1; key trainees and their training period are also shown on these. Figure 4-3 describes the manpower loading on a monthly basis at ESCES for the SITE experiment.

4.2.5 Reviews

All the main internal design and operations reviews held at ESCES, reviews held with other Indian units involved in the SITE experiment and/or NASA are spelled out in this section. Their date and the major actions and decisions that would result from these are to be tabulated as in Table 4-2.

4.2.6 Details of Test Plans

Many of the desired operations can be assured for the SITE experiment, only after performing sufficient tests on various subsystems and systems. These tests are to be carefully planned with the overall systems considerations in view. To ensure this detailed test plans are generated for each test involved and these are reviewed and accepted by authorized personnel before performing tests.

NOTE

Many other units involved in SITE, such as ESD, SCSD, etc., also have similar tests, e.g. ESD, SCSD will also have test plans for SITE integration tests and they will address ESD, SCSD, etc., portions of it respectively. To avoid confusion, the titles should be Test Plan for ESCES S/C Compatibility Tests, Test Plan for ESCES Participation in TRUST, Test Plan for ESCES SITE Integration Tests and so on. Also while giving numbers to these test plans SAC should ensure co-ordinated numberings to avoid confusion.

4.2.6.1 Spacecraft Compatibility Tests. This will be a joint test plan written by ISRO and NASA. These are meant to test the integrated ATS-F spacecraft with the SITE ground terminals. Some of the uplink portions will be simulated whereas the front-end

converter, etc., will be as used for the SITE experiment. Main stress would be the evaluation of TV performance parameters for combined S/C and ground direction reception sets made in India.

4.2.6.2 Communication Links to NASA. Well before the SITE experiment's regular broadcasts begin, communication links (both TTY and voice links) will be set up between ESCES, Ahmedabad and Hybrid terminal at Madrid. These will be set up to NASCOM standards. A detailed test plan will be generated (i) for acceptance of regular operation of these links and (ii) periodic tests on these to assure their good condition before and during the SITE experiment.

4.2.6.3 Participation in the TRUST Experiment (Television Relay Using Small Terminals). The purpose of the TRUST experiment is to advance and promote the technology of wideband satellite communications to small ground terminals by developing and demonstrating a pilot system using the ATS-F spacecraft with its high-gain parabolic reflector. Specific program goals are:

- To test and evaluate an experimental system for FM relay of black and white and color television signals (and associated sound) between the ATS-F spacecraft and a UHF receiving facility

- To evaluate the performance of the pilot system relative to experiment design objectives and internationally recognized and accepted standards for television transmission systems

- To observe the effects of ionospheric dispersion on system performance as a function of electron density, ground station location, and other system variables, and compare with theoretical predictions

- To provide interested underdeveloped countries an opportunity to participate in tests and demonstrations of a high EIRP satellite suitable for national ETV using inexpensive receivers, and to provide advice and consultation in the design and implementation of suitable receivers for such systems.

The TRUST experiment basic system will consist of a high-power microwave transmitting terminal for earth-to-satellite communications, the ATS-F spacecraft with a microwave-to-UHF

communications repeater, and a pilot mobile UHF ground receiving facility. The earth-to-satellite communications will be accomplished by using existing NASA microwave facilities at Rosman Station, North Carolina, or the Mojave Station near Barstow, California, or both. Extensive research will be conducted to develop and evaluate low-cost, consumer quality receiving terminals. It is anticipated that terminal costs can be held to less than $200 in large volume production.

As TRUST experiment is a thorough technical evaluation of many aspects of interest to SITE and follow-on systems, the participation in this by the SITE experimenters would be useful. A test plan will describe the details of such a participation, scope of tests, etc.

4.2.6.4 SITE Integration Tests. SITE integration means putting together various elements that are involved to bring forth an operational SITE experiment. ESCES operations plan will address all the portions that are involved in ESCES: to quote a few are 14 m (46 ft) antenna system, 30 ft UHF antenna, receiver systems, redundant units, HPA's, test "gears", SITE control center equipment, various communication links to NASA and to other Indian agencies, VHF rediffusion transmitters, studios, etc. Putting together these to give an effective system at ESCES involves detailed planning and tests and these will be described in this ESCES SITE integration plan. In trouble-shooting and also to judge the adequacy of certain tests during integration, one may have to refer to component/assembly tests. For example, it may be that tests to study the effect of power supply fluctuations on HPA power output may be omitted if adequate tests on HPA assembly had already been done. For the SITE various such component/assembly test procedures and reports will be internal to the respective units. So, for the SITE experiment, in order to facilitate easy traceability of such test procedures/reports, as and when need arises, all such relevent test procedures/reports shall be quoted under the heading of Applicable Documents. As is needed for all test plans, equipment required, the criteria of acceptance, etc., will be indicated.

4.2.6.5 Simulation Tests to Demonstrate Pre-Drift Readiness. Before drifting the ATS-6 toward India, a Readiness review will be done by ATS Project and SAC. To provide data base for such a review and subsequent decision, simulation tests will be performed at ESCES. Depending on the agreed simulation-equipment

(whether it is the transponder simulator or something equivalent), the plan will describe the test, parameters measured, criteria used, etc., to ascertain pre-drift readiness. Any link calculation involved should be tabulated.

4.2.6.6 ATS-6 Horizon Viewing Tests. When ATS-6 starts drifting toward India, it will reach the horizon of ESCES antenna in about one month. It will take a few more days of spacecraft maneuvering to circularize the orbit and make it stationary at 35°E. During this period of ATS-6 appearing on the horizon and becoming stationary at 35°E, many tests will be conducted that will debug many systems problems on both S/C and ground systems operations — such as sequencing commands, certain evaluation of overall uplink to S/C to downlink transponder nonlinearities, adjustment of preemphasis at ground station, certain attitude sensor operations, etc. Also co-ordination problems with Madrid can be evaluated. These will be described in this test plan along with test criteria, alternative corrective possibilities, etc. Link calculations should be written down for average and worst cases.

4.2.6.7 Stop Maneuver Tests. When the S/C orbit is circularized and stopped at 35°E, it will be done as per the STOP plan generated by GSFC. During this stop maneuver and immediately following ESCES will conduct few tests with the S/C to evaluate any drifts in the S/C, any problems in tracking the S/C with C-band antenna, signal quality, telemetry indications, etc. Also one day ranging will be done with ATS-R. Also co-ordination with other Indian stations such as Earth stations and Nagpur may be involved. These are described in this, with test methods, criteria and corrective actions, if any. Link calculations as applicable should be written down.

4.2.6.8 SITE Operations Systems Checkout. This test plan will describe all tests required to evaluate operational adequacy and preparedness of the total SITE system before the start of SITE experiment and the portions involved in ESCES will be described here. Since the SITE operations control center is housed in ESCES and also because ESCES is the Prime Station and contact point between ISRO and NASA, the ESCES test plan for this will be the OVERALL SITE OPERATIONS CHECKOUT PLAN. This need not repeat all the plans of Software Operations Checkout, Cluster Operations Checkout, etc., but should quote/refer to them, as and when needed for execution of responsibilities at the SITE

control center; this thus becomes the controlling operations checkout document. This, thus should be closely co-ordinated with all participants of the SITE experiment operations. All applicable link calculations should be shown for average and worst cases.

The SITE experiment is being conducted as a test bed for the development of a satellite based national TV system for India. Consequently, it is extremely important that the entire system employed for the conduct of this experiment be maintained at a peak level of performance to minimize the down time and to impact favorably on the viewer with respect to picture and sound quality. This also means that broadcast adheres to published schedules insofar as possible, clusters be maintained well, the SITE operations control center effectively coordinates all elements of the SITE experiment operations.

To evaluate such a preparedness before regular broadcasts begin, this test plan will spell out all the checkouts needed on operational elements: on all technical interfaces, communication links, administrative and logistic supports, etc. The test plan and its execution will be the responsibility of ATS Mission Operations Manager at ATSOCC and SAC Operations Manager at the SITE Operations Control Center (SITEOCC) at ESCES, Ahmedabad.

When these tests begin the S/C will be stationary over 35°E and all the tests described before would have been conducted. This tests covers the total system checkout, simulated broadcast schedules, station-to-station handover tests, tests on acquisition of information from special validation clusters, Earth stations, studios, Nagpur stations, evaluation of data, etc.

Once these tests are completed satisfactorily, the total SITE system is ready for demonstration to top India and U.S. officials (e.g., Prof. Dhawan, Chairman, ISRO). After such a demonstration and review, regular broadcasts begin.

4.2.6.9 SITE Demonstration Tests. Again this test though generated at ESCES, will cover the total SITE system, because once all SITE elements are integrated including successful stationkeeping of S/C, SITE Operations Control Center deals with a total integrated system. Thus this plan should co-ordinate all elements of the SITE experiment. Essentially this plan describes

the methods and means to demonstrate the readiness of the total SITE system for regular scheduled broadcasts to top officials in India and U.S. Once these demonstrations are successfully completed, the SITE system is ready for regularly scheduled broadcasts. All applicable link calculations for this test are to be referred.

4.2.6.10 Tests During Scheduled Broadcasts. The healthy operations of the SITE system just starts after system operations checkout and SITE demonstrations. This system needs to be maintained as a viable experiment. It is further to be noted after 4 to 6 hours (or fractions thereof) of the SITE experiment, the S/C will be maneuvered for other experiments, e.g., ATS experiments over Europe. Thus daily the start of SITE broadcasts involves:

- Acquisition of the S/C
- Prebroadcast alignment and set up
- Broadcasts
- Post Broadcast analysis and evaluation
- RARR (Range & Range Rate) would be for 24 hours periodically as determined later
- Periodic SITE interface tests

A list of the tests is tabulated in Table 4-3.

As Table 4-3 shows, the ESCES tests during regular broadcasts necessarily involve monitoring the whole system, e.g., the ESCES Site Operations Control Center has to query about the standby readiness of Bombay and Delhi stations; they may have elaborate procedures for this. The SITE Operations Control Center (SITEOCC) has to develop adequate means of getting necessary information on parameters of these Earth stations and SITEOCC should fix the parameters as deemed necessary for smooth SITE operations. Similar cases could be explained for special validation clusters, rebroadcast stations and so on. Thus this plan should cover all aspects of SITE and take into account many interfaces indicated in paragraph 4.6 of this volume as applicable for daily broadcasts. For example periodic

tests of communications links are to be done; ranging is to be done 24 hours periodically, Nagpur station status ascertained and so on.

All applicable link calculations should be written down for average and worst cases. These tests will continue till the SITE experiment ends.

4.2.7 ESCES Data Management Plan

This section is devoted to technical data management for the SITE experiment. Data collection is required before and after regular broadcasts begin, though they differ during this period. Technical data defined herein also includes administrative (non-technical) data such as schedules, dispatch and stocks of broadcast tapes, monitoring services of special events for broadcasts as and when situation arises and so on. Again as in test plans, ESCES being the seat of SITEOCC should collect all the necessary system data from an overall viewpoint of bringing an operational SITE system into being and maintain it effectively. Thus many data regarding portions of paragraph 4.6 have to be done or controlled by SITEOCC and these also should be addressed here.

4.2.7.1 Data Requirements at ESCES. Data is collected both in India and by the Hybrid Terminal at Madrid. In India, ESCES is designated as the central collection point for all data acquired by the transmit-receive and receive only terminals including that from the direction reception clusters and rediffusion sets. In addition ATSOCC provides ESCES, i.e., SITEOCC and the Hybrid with S/C schedules and ephemeris data.

Data are collected during the S/C stopping phase, operational checkout phase after stationing the S/C (system debugging tests) and also during demonstrations. These are more of diagonistic and developmental type data. Many system specialities, preferred approaches, etc., come out of these. These are evaluated by ATSOCC and SITEOCC, on immediate basis for setting up the SITE regular broadcasts. Later they will be studied in detail for furthering knowledge.

During regular broadcasts the data are mostly of routine nature. These are as under:

Daily for each station as appropriate

- Transmit/receive station antenna pointing angles
- Transmit power

- Received UHF signal level (AGC); fading
- Picture and sound quality comments from various stations
- Weather — Detailed data during broadcast
- Outages
- Polarization Angles
- VSWR
- HF inogram data
- Readiness of back-up stations and Nagpur
- Instructions from ATSOCC and Hybrid
- Reports from Special Validation Clusters.

Weekly

- Ground equipment performance test results
- Link performance tests results
- Progagation test results and relevant ionospheric data
- Field reports summary (direct reception receivers including VHF rediffusion sets identified for SITE evaluation)
- Stock and delivery position of program tapes/films
- Communication links (TTY, voice, etc.) link check reports
- Rebroadcast station (including limited rebroadcast) status.

Every Other Week

- Broadcast and special test schedule requirement (two weeks in advance)
- RARR data as and when taken
- Special technical and operational suggestions after detailed reviews of many reports (periodic inputs).

4.2.7.2 Data Requirements at TGS (Hybrid), Madrid. Many comments in the earlier Section 4.2.7.1 apply here too regarding the type of data and data during set-up of SITE experiment.

Data requirements during regular SITE broadcast phase are as under:

Daily

- Antenna pointing angles
- Spacecraft attitude
- Spacecraft telemetry data including as a minimum UHF and C-band transmit power and C-band received signal level
- Picture and sound quality comments
- Weather data
- Outages
- RARR Data as and when taken
- Instructions from ATSOCC and SITEOCC (ESCES)

4.2.7.3 Data Requirements at ATSOCC. Here too many comments regarding operational set-up phase as done in 4.2.7.1 apply.

Data requirement during regular SITE broadcasts are:

Daily

- Spacecraft ephemeris data
- Spacecraft status report
- Daily operations report
- Instructions from Hybrid and SITEOCC

Weekly

- Spacecraft schedule
- Weekly operations report
- RARR Schedule as and when required

4.2.7.4 Data Transfer. Methods of transferring the SITE data for evaluation are an important aspect to be done by SITEOCC; the SITEOCC mainly will be concerned with such a processing and evaluation of SITE data as would be applicable for immediate SITE operations, e.g., analysis of field reports to see the signal quality statistics and possible reasons of poor quality and

suggested attempts for improvements and so on. Many long term-oriented data analysis is not the concern of SITEOCC. This section should also address (in Vol. II) the portions and extent of data collected in India that will be transmitted to ATSOCC and Hybrid, for construction of the SITE.

There are no requirements for the transfer of data in real time. The principal method of data transfer is to be by TWX. ESCES and the Hybrid are to be on the distribution list for the ATSOCC daily and weekly operations reports. However, because of the long mailing time, information pertinent to the SITE experiment must be disseminated by TWX.

4.2.7.5 Supporting Data Requirements.

Communication

The lines of communication are shown in the plan, Figure 4-4. For the purpose of illustration, the Hybrid is shown located at a European site.

Full duplex TWX (one each) and SCAMA voice (two each) lines are required between ATSOCC and the Hybrid. The principal means of international communications from India is now via INTELSAT through the OCS terminal at ARVI. Interconnection in Europe in this example is effected through the NASCOM switching center the European traffic center. Dial-up telephone, supplemented as necessary by TWX, is utilized locally within India.

A half-duplex C-band channel through the s/c is available as an emergency back-up between India and the Hybrid.

Orbital Computing Plan

The NASA Trajectory Analysis and Geodynamics Division (TAGD) is responsible for orbit determination, computations for s/c maneuvers, and production of the ephemeris data for the experimenters.

The raw data for the production of s/c ephemeris is derived from RARR and antenna pointing angles from the Hybrid and the Ahmedabad earth terminal. The Operational Computing Branch (CD) at NASA performs the computation in a program which includes the effects of solar radiation, luni-solar gravitation, and tesseral harmonics of the earth's potential.

RARR measurements are conducted by the Hybrid and Ahemdabad at intervals to be determined. This requires five minutes each hour for 24 successive hours. RARR antenna pointing angles, and time are transmitted to ATSOCC via TWX. Ephemeris data is to be available approximately two days after receipt of the input data. Data pertinent to the experiment s/c time is transmitted to the Hybrid and to Ahmedabad on a daily basis.

4.2.8 Prime Station ESCES Operational Procedure for Scheduled Broadcasts

4.2.8.1 Site Broadcast Operations Plan

General Set-Up of the Transmit Facility

Three ground stations, one each at Ahmedabad, Bombay and Delhi, will be established and will have the facility to transmit TV programs to the s/c on C-band. On the basis of a detailed day to day scheduling, one of the ground stations will irradiate the s/c with the TV signals on C-band. Standard cue words and signals will be included in the programming to enable the next ground station to take over transmission of the following program, if any. The technical coordination and control of these earth stations will be carried out by the main operations control at ESCES, Ahmedabad (by SITEOCC).

General Set-Up of the Receive Facility

The s/c receives the C-band TV signals from any one of the three ground terminals and relays back to ground via the UHF feed and 30-ft dish. The beam center of the downlink is near the center of India. Four ground stations for receiving these signals, one each at Ahmedabad, Bombay, Delhi and Srinagar in Kashmir Valley are planned. All these ground stations receive the TV signals on UHF down convert and extract the baseband TV and audio signals and rebroadcast over a conventional VHF television transmitter choosing one of the audio signals. This rebroadcasting or rediffusing facility will serve the area around these cities. The technical coordination and control will be with the main operations control at ESCES at Ahmedabad (SITEOCC).

Ground Station to VHF TV Transmitter Link

At Ahmedabad, the VHF TV transmitter location is not finalized and as and when it is finalized, it is planned to link this transmitter

to the Ahmedabad Ground Station for the purposes of transferring the TV programs by a microwave link.

At Delhi, the VHF transmitter is located in the heart of the city. The location of the Earth station is to be decided yet. The link between these will be a microwave link. Similar will be the link at Bombay and Srinagar.

Ground Station to Studio Link

The link between the studio or the program originating facility and the ground station transmitter at Ahmedabad, Bombay and Delhi is to be determined. Most likely these will be by microwave links.

Direct Reception Facility

In five or six different locations which are not served by any of the four VHF rediffusion stations (probably selected out of the following areas: Madras, Calcutta, Rajasthan, Madhya Pradesh, Orissa, Bihar and Uttar Pradesh). About 500 receivers in each area will be installed and these receivers will receive signals directly from the s/c. To enable this, the conventional TV receiver will be fed from an antenna of 10' diameter facing the s/c and a front end converter. The front end converter converts the s/c UHF signals into a conventional VHF TV signal choosing any one of the two audio channels such that this signal is compatible with the conventional TV receiver.

VHF Rediffusion Facilities

Most of the VHF rediffusion receivers are served by regular AIR VHF stations at Srinagar, Delhi, Bombay. Many community sets will be provided by many local agencies, State governments besides individuals residing in this area equipping their homes with personal sets. A minimum of 2000 VHF community TV sets will be identified by ISRO, in coordination with other Indian agencies involved, for the purposes of SITE experiment technical and social evaluation.

Limited Rebroadcast Facilities

Few low power (100w to 50w) VHF TV transmitters will serve some areas for VHF rediffusion. These facilities thus include

the VHF transmitter systems and TV sets they serve (located in villages).

Nagpur Station

This will serve as a ground beacon for s/c monopulse and possibly interferometer. This is to provide a back up for s/c pointing in case of any anomalies in the attitude control system of s/c.

Special Validation Clusters

To evaluate the quality of s/c signals at VHF rediffusion centers and direct reception sets during s/c acquisition of start of daily SITE broadcasts, the special validation clusters having about 15 representative sets will be formed in many parts of India. They will communicate their reports to SITEOCC, to facilitate better operations and assurance of good signals to direct and rediffusion sets.

Broadcasting and Back-Up Plans

It is planned to have four hours to six hours of TV broadcasting every day. This period of four to six hours may be in one one-time frame or it may be divided into two periods of two to three hours each. The time frame is to be determined.

The transmissions to the s/c will be from any of the three ground stations and detailed day to day scheduling will indicate time at which any particular Earth station comes up on air, indicate the time at which changes over to a second ground station, if any, and will also indicate the cue for the change over.

The SITE Experiment envisages Ahmedabad to be the main or prime ground transmitting station. Bombay ground transmitting station is being planned to remain a hot standby which will take up transmission in case there is a breakdown in system. Similarly, Ahmedabad will be a hot standby for Bombay and Delhi stations and will take over transmission if the system in Bombay or Delhi fails. To enable this, a copy of the program should be made available to the standby station by the originating station at best, one week in advance. The coordination regarding the hot standby going on air will be done through the order wire circuits existing between the various stations.

Order Wire Circuits

A main control center will be set up at ESCES, Ahmedabad and this will be under the control of the SITE Operations Director. One voice and one teletype link from main control center to TGS in Europe on a 4-wire basis via NASCOM in Madrid will be provided for operational communications. At the NASCOM switching center facility exists to connect this voice and/or teletype channel to ATSOCC in GSFC. This voice and teletype link will be made available on a 24 hour basis.

In addition, all the four ground terminals, Ahmedabad, Bombay, Delhi and Srinagar, will be connected to the main control center by voice and teletype links. For the technical coordination, there will be order wire voice circuits between the ground stations and the respective VHF transmitters and studio/program originating facility.

Tests

To assess the performance of the various ground equipments, a list of tests is made up and Table 4-4 indicates the frequency at which these tests are performed.

The daily tests will be carried out by all the transmitting stations in turn through the s/c daily before the broadcast. The weekly tests will be performed through the s/c by one station during each week by turn and the other stations would do these tests through the RF TLTs in their respective stations. All these test results will be forwarded to the main control center every week for study and assessment. All these pre-broadcast tests will be completed at least ten minutes before the scheduled broadcast time. During this ten minute period, a standard test chart and a test tone (one for each audio channel) will be broadcast to facilitate the receiving installations to line up the system. If any post-broadcast tests are planned by way of diagnostic, maintenance, etc., or for any other experimentation, these tests will be conducted at least five minutes after the broadcast is over.

Apart from these, the receiver maintenance centers located at Madras, Calcutta, Srinagar and Bombay areas will assess the received s/c signal and communicate to the main operations control center by phone or teletype if the received signal is not up to the expected level.

Table 4-4

Test Schedule

Type of Schedule	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Daily	A,B,G, K,P	A,B,G, K,P	A,B,G, K,P	A,B,G, K,P	A,B,G, K,P	A,B,G, K,P	A,B,G, K,P
Weekly	D	C,F,H,I	J	L	M	N,O	Q,E

Note: Range and Range Rate measurements will be taken as per required schedule which will take into consideration these routine daily and weekly tests at predetermined hours.

Broadcasting Schedule

The detailed program schedule for TV broadcasting will be prepared by the program originators. This will indicate item wise programs with their opening and closing times, originating area or station, change over cues, etc. This will be made available to the main operations control center at two weeks in advance so that Earth station scheduling and coordination could be done effectively.

Frequency Plan

Each ground transmitting station will have two transmitters operating on the same frequency. One will be a hot standby to the other.

When both the transmitters fail at a station when transmissions are going through from that station, then the main operations control will contact the Hybrid and ATSOCC to configure the s/c for an uplink frequency corresponding to the standby station. When it is confirmed that the s/c has been configured properly, the standby station will restart the broadcasting. This process will involve a down time of at least five minutes.

A frequency plan is given in Table 4-5.

4.2.8.2 Site Operations Control.

Operations Control Center

An operations control center, SITEOCC will be set up at ESCES Ahmedabad to coordinate the various activities of SITE Experiment

Table 4-5

Frequency Plan

Station	Normal Operation	Standby Operation	RARR
Ahmedabad	6150 MHz	6150 MHz	5950 MHz
Bombay	6350 MHz	6350 MHz	—
Delhi	6350 MHz	6350 MHz	—

Note: No RARR activity is shown against Bombay and Delhi stations as this facility to be proposed to be installed only at Ahmedabad.

on one side and the Hybrid and ATSOCC on the other. SITEOCC will be under the control of the SAC Operations Manager.

Duties and Responsibilities of Control Center

The SITE Operations Control Center will be responsible to coordinate the various activities of SITE Experiment and effectively put through the TV program for broadcast. This center will have an overall control of the communication network to NASCOM at Madrid, and to various Earth stations, studio and VHF transmitting stations. This center will plan and schedule Earth stations for broadcasting, for carrying out routine maintenance tests, arrange for special diagnostic tests, etc., in coordination and consultation with the Hybrid and ATSOCC. The results of the various tests conducted at the different Earth stations will be made available to the center where these will be studied and analyzed. The RARR data made available by ESCES will be transmitted to GSFC via the teletype link.

The control center will be responsible to authorize a back-up station to come up on air for broadcast, if the scheduled prime station fails. The coordination in this regard, in contacting ATSOCC and Hybrid to get the spacecraft reconfigured, will be done by the control center. After verifying the s/c has been reconfigured as required, the back-up station will be authorized to go on air.

The reports, if any, from the receiver maintenance centers in Bombay, Madras, Calcutta and Delhi/Srinagar will be analyzed for proper orientation or attitude of the s/c. If any discrepancies

are noticed, Hybrid and ATSOCC will be informed to check and correct as required.

It is the responsibility of the SAC Operations Manager to see that the control center works smoothly and efficiently.

SITEOCC — ATSOCC Interface

The SITEOCC is responsible for the conduct of the SITE Experiment in India and will be the agency coordinating all the activities of the various constituent units of the experiment in India. In addition will organize different tests and measurements that may be required for efficient experimentation and for the s/c orbital determination. These data will be transmitted to ATSOCC.

ATSOCC will supply orbital data or predicts for the various Earth stations in India. Will also arrange to configure the s/c for different uplink frequencies as may be required, maintain the proper attitude of s/c antenna pointing.

4.3 INDIAN EARTH STATIONS OPERATIONS PLAN

These include Bombay, Delhi transmit-receive stations, associated links to AIR VHF transmitters and studios; and receive only station at Srinagar and its link to AIR VHF transmitters.

4.3.1 Functions

The Srinagar station acts as a receive-only facility which receives signal from s/c and connects it to the VHF rebroadcast (AIR) station that serves Kashmir Valley.

The Earth stations at Bombay and Delhi not only serve the above function in their respective localities, but also serve as uplink transmit stations to s/c, if the need arises; they thus serve as back-up stations to ESCES.

4.3.2 Organization Chart

Figure 4-5 describes the Organization Chart of Satellite Communication Systems Division (SCSD) which is responsible for the Indian Earth Stations. It lists the key personnel connected with the SITE experiment.

4.3.3 Schedules

Detailed milestone charts showing all important development and operational activities done by SCSD for the SITE experiment are shown in Figure 4-6. The activities such as completion of test plans, reviews, etc., are also shown on these milestone charts.

4.3.4 Manpower Requirements

The manpower involved at SCSD for the SITE experiment both for development and operations are shown in Table 4-6; key trainees and their training period also is shown on these. Figure 4-7 describes the manpower loading on monthly basis at SCSD for the SITE experiment.

4.3.5 Reviews

All the main internal design and operations reviews held at SCSD with other Indian units involved in the SITE experiment and/or NASA are spelled out in this section. Their date and major actions and decisions that would result from these are to be tabulated in Table 4-7.

4.3.6 Details of Test Plans

Many of the desired operations can be assured for the SITE experiment, only after performing sufficient tests on various subsystems and systems. These tests are to be carefully planned with the overall systems considerations in view. To ensure this detailed test plans are generated for each test involved and these are reviewed and accepted by authorized personnel before performing tests.

NOTE

Many other units involved in SITE, such as ESD, ESCES, etc., also have similar tests, e.g. ESD and ESCES will also have test plans for SITE integration tests and they will address ESCES, ESD, portions of it respectively. To avoid confusion, the titles should be Test Plan for SCSD s/c Compatibility Tests, Test Plan for USCSD Participation in TRUST, Test Plan for SCSD SITE Integration Tests and so on. Also while giving numbers to these test plans SAC should ensure coordinated numberings to avoid confusion.

4.3.6.1 Spacecraft Compatibility Tests. This will be a joint test plan written by ISRO and NASA. These are meant to test the integrated ATS-F spacecraft with the SITE ground terminals. Some of the uplink portions will be simulated whereas the front-end

converter, etc., will be as used for the SITE experiment. Main stress would be the evaluation of TV performance parameters for combined s/c and ground direction reception sets made in India. ESCES and ESD will be the main participants in this test; SCSD can coordinate this plan with ESCES and combine their inputs with ESCES plans.

4.3.6.2 Communication Links to the Prime Station (ESCES). Well before the SITE experiment regular broadcasts begin, communication links (both TTY and voice links) will be set up between ESCES, Ahmedabad and the Earth stations. It may be that the receive only station, Srinagar, need only have a TTY link to the SITEOCC in ESCES. The Delhi and Bombay Earth stations need voice and TTY links for take-over of back-up transmission. These links have to be set up to accepted standards. A detailed test plan will be generated (i) for acceptance of regular operation of these links and (ii) periodic tests on these to assure their good condition before and during the SITE experiment. Links to studios and AIR stations should also be addressed here.

4.3.6.3 Participation in the TRUST Experiment (Television Relay Using Small Terminals). Reference should be made to paragraph 4.2.6.3. Again for this ESCES and ESD will be the main participants and inputs should be given to the ESCES for generating the test plan for this experiment.

4.3.6.4 SITE Integration Tests. SITE integration means putting together various elements that are involved to bring forth an operational SITE experiment. Earth stations operations plan will address all the portions that are involved in Earth stations: to quote a few are 30 ft dishes, transportable power supply system, links to studios, HPA's various test equipment and so on. Putting together these to give an effective system at Earth stations involves detailed planning and tests and these will be described in this Earth station SITE integration plan. In trouble-shooting and also to judge the adequacy of certain tests during integration, one may have to refer to component/assembly tests. For example, it may be that tests to study the effect of power supply fluctuations on HPA power output may be omitted if adequate tests on HPA assembly had already been done. For the SITE, various such component/assembly test procedures and reports will be internal to the respective units. So, for the SITE experiment, in order to facilitate easy traceability of such test

procedures/reports, as and when need arises, all such relevant test procedures/reports shall be quoted under the heading of Applicable Documents. As is needed for all test plans, equipment required, the criteria of acceptance, etc., will be indicated.

4.3.6.5 Simulation Tests to Demonstrate Pre-Drift Readiness. Before drifting the ATS-6 toward India, a Readiness review will be done by ATS Project and SAC. To provide data base for such a review and subsequent decision, simulation tests will be performed at the Earth stations. Depending on the agreed simulation - equipment (whether it is the transponder simulator or something equivalent), the plan will describe the test, parameters measured, criteria used, etc., to ascertain pre-drift readiness. Any link calculation involved should be tabulated.

4.3.6.6 ATS-6 Horizon Viewing Tests. When ATS-6 starts drifting toward India, it will reach the horizon of antennas of Earth stations in about one month. It will take a few more days of spacecraft maneuvering to circularize the orbit and make it stationary at 35°E. During this period of ATS-6 appearing on the horizon and becoming stationary at 35°E, many tests will be conducted that will debug many systems problems on both s/c and ground systems operations — such as sequencing commands, certain evaluation of overall uplink to s/c to downlink transponder nonlinearities, adjustment of pre-emphasis at ground station, certain attitude sensor operations, etc. Also coordination problems with the Prime station, SITEOCC can be evaluated. These will be described in this test plan along with test criteria, alternate corrective possibilities, etc. Link calculations should be written down for average and worst cases.

4.3.6.7 Stop Manuever Tests. When s/c orbit is circularized and s/c stopped at 35°E, it will be done as per STOP PLAN generated by GSFC. After stop maneuvers the Earth stations will do transmission and reception to the s/c as directed by the SITEOCC. Coordination with SITEOCC, Earth station - s/c links, etc., will be tested during this period. These are described in this, with test methods, criteria and corrective actions, if any. Link calculations as applicable should be written down.

4.3.6.8 SITE Operations Systems Checkout. This test plan will describe all tests required to evaluate operational adequacy and preparedness of the total SITE system before the start of SITE experiment

and the portions involved in the Earth stations will be described here. Keeping in view that Srinagar Earth station and other two, i.e., Bombay and Delhi are back-up stations to the Prime stations, the OPS checkout plan should cover all the functions covered by these stations. The close coordination with SITEOCC and methods of testing operational preparedness for back up during the SITE experiment, to ESCES, etc., should be addressed. The applicable link calculations should be shown for average and worst cases.

The SITE experiment is being conducted as a test bed for the development of a satellite based national TV system for India. Consequently, it is extremely important that the entire system employed for the conduct of this experiment be maintained at a peak level of performance to minimize the down time and to impact favorably on the viewer with respect to picture and sound quality. This also means that broadcast adheres to published schedules insofar as possible, and interruptions are few. To ensure this receive Earth station (Srinagar) should be ready for linking to AIR, interfaces well checked out and so on. The transmit-receive stations Bombay and Delhi should be ready for taking over uplink transmissions with minimum delay. The test plan should spell out tests needed on operational elements: on all technical interfaces (e.g., communication links to SITEOCC), administrative and logic supports, etc. The test plan and its execution will be the responsibility of the Project Manager, Earth station or individual Station Directors as appointed by him. Wherever tests are done with the coordination of SITEOCC, the SAC Operations Manager needs to have control over certain tests as deemed necessary. These details are to be worked in coordination with the ESCES OPS checkout plan which addresses the total SITE OPS checkout plan. (See paragraph 4.2.6.8)

Once these tests are completed satisfactorily, the total SITE system is ready for demonstration to top India and U.S. officials (e.g., Prof. Dhawan, Chairman, ISRO). After such a demonstration and review, regular broadcasts begin.

4.3.6.9 SITE Demonstration Tests. Essentially this plan describes the methods and means to demonstrate the readiness of the total SITE system for regular scheduled broadcasts to top officials in India and U.S. Once these demonstrations are successfully completed, the SITE system is ready for regularly scheduled

broadcasts. All applicable link calculations for this test are to be referred.

This test plan for Earth station will address those portions that will be applicable to the Earth stations; it should be coordinated with the ESCES plan as SITEOCC is the main controlling body during the overall demonstration. See paragraph 4.2.6.9.

4.3.6.10 Tests During Scheduled Broadcasts. The healthy operations of the SITE system just starts after system operations checkout and SITE demonstrations. This system needs to be maintained as a viable experiment. It is further to be noted after 4 to 6 hours (or fractions thereof) of the SITE experiment the s/c will be maneuvered for other experiments, e.g., ATS experiments over Europe. Thus daily the start of SITE broadcasts involves:

- Acquisition of the s/c
- Prebroadcast alignment and set up
- Broadcasts
- Post broadcast analysis and evaluation
- Periodic SITE interface tests

A list of these tests is tabulated in Table 4-8.

The tests for the individual stations differ for transmit-receive stations and receive-only stations. The tests should be all those needed to report to the SITEOCC the operational readiness for reception and back-up functions as applicable. It should be coordinated with the ESCES plan (see paragraph 4.2.6.10). These tests will continue till the SITE experiment ends.

4.3.7 Indian Earth Station Data Management Plan

This section is devoted to technical data management for the SITE experiment. Data collection is required before and after regular boradcasts begin, though they differ during this period. Technical data defined herein also includes administrative (non-technical) data such as schedules, dispatch and stocks of broadcast tapes, monitoring services of special events for broadcasts as and when situation arises and so on. Special requirements of transmit-receive stations as against receive only station should be detailed.

4.3.7.1 Data Requirements at Bombay. Data are collected during the s/c stopping phase, operational checkout phase after stationing the s/c (system debugging tests) and also during demonstrations. These are more of diagonistic and developmental type data. Many system specialities, preferred approaches, etc., come out of these. These are evaluated by ATSOCC and SITEOCC, on immediate basis for setting up the SITE regular broadcasts. Later they will be studied in detail for furthering knowledge.

During regular broadcasts the data are mostly of routine nature. These are as under:

Daily for each station as appropriate

- Transmit/receive station antenna pointing angles
- Transmit power
- Received UHF signal level (AGC); fading
- Picture and sound quality comments from various stations — nearby VHF receivers
- Weather — Detailed data during broadcast
- Outages
- Polarization Angles
- VSWR
- HF ionogram data
- Instructions from SITEOCC
- Reports from Special Validation Clusters

Weekly

- Ground equipment performance test results
- Link performance tests results
- Propagation test results and relevant ionospheric data

- Field reports summary (direct reception receivers including VHF rediffusion sets identified for SITE evaluation)

- Stock and delivery position of program tapes/films

- Communication links (TTY, voice, etc.) link check reports.

- Rebroadcast station (including limited rebroadcast) status

Every Other Week

- Broadcast and special test schedule requirement (two weeks in advance)

- Special technical and operational suggestions after detailed reviews of many reports (periodic inputs)

The conduction and deletion of some of these data may be controlled by the SITEOCC during day to day operations, e.g., to conserve time, when the back-up stations are operating the SITEOCC may decide to skip some data. Some of the data like picture and sound quality comments from various stations may be applicable only when Bombay station is broadcasting the uplink. Or else, it may well be decided that all uplink stations collect this data (and be ready for operation) on a daily basis; these are the details that will be worked at a later date by the SITEOCC in consultation with Earth stations. However, these should be addressed in the Earth station's operations plan; subject to later revision.

4.3.7.2 Data Requirements at Delhi Earth Station. This is exactly same as for Bombay and thus paragraph 4.3.7.1 should be referred to.

4.3.7.3 Data Requirements at Srinagar. Being a receive station the functions are limited.

Daily

- Receive antenna preferred pointing angle

- Received UHF signal

- Picture and sound quality from Kashmir Valley VHF receivers

- Outages
- Polarization
- VSWR
- Weather, HF ionograms
- Instructions from SITEOCC

Weekly

- Ground equipment performance test results
- Link performance test results
- Propagation test results and relevant ionospheric data
- Kashmir Valley VHF receivers reports summary
- Communication links (TTY, voice or telegraph)
- Rebroadcast (VHF AIR) station status

4.3.7.4 Data Transfer. The Earth stations will keep the SITEOCC informed of all data that are applicable for the operation of the SITE experiment, as is agreed upon.

There are no requirements for the transfer of data in real time. The principal method of data transfer is to be by TWX. ESCES and the Hybrid are to be on the distribution list for the ATSOCC daily and weekly operations reports. However, because of the long mailing time, information pertinent to the SITE experiment must be disseminated by TWX.

4.3.7.5 Supporting Data Requirements.

Communication

The lines of communication are shown in the plan, Figure 4-4. For the purpose of illustration, the Hybrid is shown located at a European site.

The Earth stations have to communicate only to the SITEOCC and other Indian units they are concerned with, e.g. Bombay Earth Station with communication with Bombay AIR Station and so on. Dial-up telephone, supplemented as necessary by TWX, is utilized locally within India.

A half-duplex C-band channel through the s/c is available as an emergency back-up between India and the Hybrid. Earth stations may exercise such a link only under instructions from the SITEOCC.

4.3.8 Indian Earth Stations Operational Procedure for Scheduled Broadcasts.

4.3.8.1 SITE Broadcast Operations Plan. This is same as 4.2.8.1. Hence the portions applicable for individual Earth station should be in coordination with the SITEOCC and should be in basic agreement as that defined in paragraph 4.2.8.1. The details as applicable to each Earth station (Bombay, Delhi, and Srinagar) should be elaborated here.

4.3.8.2 Interface with the SITE Control Center. All the administrative and technical interfaces (voice links, Telex links or telegraphic facilities as the case may be) should be exercised daily to keep a check on the operational integrity of the system. Daily at specified times before broadcasts certain tests should be run on these; the specific tests and pass/fail criteria and alternatives should be mentioned in this. These will differ for Srinagar and Bombay/Delhi stations. These differences should be brought out.

4.3.8.3 Interface Between Earth Stations. Besides interfaces between the Earth stations and the Prime station, there will be certain links maintained between the Earth stations, as the Earth stations have vital role to play as transmit stations. The daily tests on these should be discussed in this section. (Vol. III)

4.4 CLUSTER SUPPORT OPERATIONS PLAN

4.4.1 Functions

The clusters as defined herein include all the Direct Reception Receive Stations, the VHF rediffusion TV sets identified by ISRO for the SITE experiment (see paragraph 3.3.1.2.6), the Limited Rebroadcast stations, their associated VHF

TV receivers, (see paragraph 3.3.1.2.7), the maintenance and logistic support centers and power supplies for the above. These are vital to the whole SITE experiment. The development, deployment, operation and maintenance of these above mentioned equipments/hardware is addressed in the Cluster Support Operations Plan.

4.4.2 Organization Chart

See Figure 4-8 which describes the Organization Chart for cluster support as related to the SITE experiment, listing key people.

4.4.3 Schedules

Detailed milestone charts showing all important development and operational activities done for cluster support for the SITE experiment are shown in Figure 4-9. The activities such as completion of test plans, reviews, etc., also are shown on these milestone charts.

4.4.4 Manpower Requirements

The manpower involved in cluster support for the SITE experiment both for development and operations is shown on Table 4-9; key trainees and their training period are also shown on these. Figure 4-10 describes the manpower loading on a monthly basis for cluster support for the SITE experiment.

4.4.5 Reviews

All the main internal design and operations reviews held for cluster support, reviews held with other Indian units involved in the SITE experiment and/or NASA are spelled out in this section. Their date and the major actions and decisions that would result from these are to be tabulated as in Table 4-10.

4.4.6 Details of Test Plans

Many of the desired operations can be assured for the SITE experiment, only after performing sufficient tests on various subsystems and systems. These tests are to be carefully planned with the overall systems considerations in view. To ensure this detailed test plans are generated for each test involved and these are reviewed and accepted by authorized personnel before performing tests.

NOTE

Many other units involved in SITE, such as SCSD, etc., also have similar tests, e.g. SCSD, etc., will also have test plans for SITE integration tests and they will address SCSD, etc., portions of it respectively. To avoid confusion, the titles should be Test Plan for Cluster Support/ESD S/C Compatibility Tests, Test Plan for Cluster Group/ESD Participation in TRUST, Test Plan for Cluster Integration Tests and so on. Also while giving numbers to these test plans SAC should ensure coordinated numberings to avoid confusion.

4.4.6.1 Spacecraft Compatibility Tests. This will be a joint test plan written by ISRO and NASA. These are meant to test the integrated ATS-F spacecraft with the SITE ground terminals. Some of the uplink portions will be simulated whereas the front-end converter, etc., will be as used for the SITE experiment. Main stress would be the evaluation of TV performance parameters for combined s/c and ground direction reception sets made in India.

4.4.6.2 Communication Links to the Prime Station. The 3000 Direction Reception Sets (DRS) do not all have a direct link to the Prime station; same is true of the specially identified (by ISRO) VHF Rediffusion Stations (VRS). But to evaluate the performance of the Direct Reception and VHF rediffusion sets during (daily) SITE experiment set-up, Special Validation Clusters (SVC) will be set up to represent various clusters all over India. These SVC's have some form of communication to the SITEOCC (either Telex, telegraph or voice links); these links are needed to communicate to the SITEOCC above the signal quality, special problems, etc., of the SVC which will provide data for the SITEOCC to make operational adjustments during daily set-up (like tilting ESCES antenna, etc., if they are the cause of poor signal). Once these communication links are decided upon and established, detailed test plans should be generated to test these for acceptance for the start of the SITE experiment and also for periodic tests during the period of experiment. Similar comment applies to Limited Rebroadcast Station (LRS) and their associated receivers.

4.4.6.3 Participation in the TRUST Experiment. Same as in 4.4.6.3. This describes the participation from the viewpoint of front-end converters and direct receiving antennas.

4.4.6.4 Production Units Acceptance Tests. All hardwares for DRS are produced in quantities of 3000. These are: chicken mesh antennas and their feeds, front-end converters, cable assemblies, power supplies, indoor units and TV sets.

After specifying acceptable objective criteria for these units (including environmental tests), typical tests should be specified to be undertaken before these units are accepted as hardware for the SITE experiment.

These are addressed in this test plan. Pass/fail criteria, sign-off provisions by responsible authorities including quality control authorities and data sheets, should be provided for in this test plan.

4.4.6.5 Direct Reception Receivers (DRR) Installation Test. After accepting the factory produced hardware, these will be dispatched to their destinations and installed at specified locations. These installations should follow carefully planned out procedures, i.e., the order in which the assembly should proceed; the specific tests/observations after each step, etc., should be clearly brought out. The explanation of the procedures should be very clear so that the installing technician can follow the steps one by one to arrive at a full unit.

4.4.6.6 Limited Broadcast Rediffusion Transmitter Tests. The low power 50 w (or 100 w) transmitters and their associated antennas should be tested for acceptable performance. These are brought out in this test plan.

4.4.6.7 Rediffusion VHF Community Receiver Evaluation Tests. Minimum of VHF rediffusion sets all over India, as mentioned earlier, will be identified by ISRO by agreement with other Indian agencies which own them. To be part of the SITE experiment evaluation these need to be tested to certain objective standards. Noting the fact that these might have been installed by other Indian agencies/bodies, ISRO will ensure that these units are evaluated for participation in the SITE experiment to meet certain minimum specified performance. Documentation of these data, frequency with which the tests will be repeated (once in 3 months or 2 months, etc.), sign-off provisions, quality-control, etc., will be brought out clearly.

4.4.6.8 Viability Tests for Special Validation Clusters. During the initial phase of sighting the s/c and the actual start of the SITE experiment (and in fact even later), tests should be done to evaluate how good representation SVC's offer for DRS and VRS. This will ensure that SVC's fulfill their functions for the SITE experiment. These tests should be described in this Viability Test Plan.

4.4.6.9 SITE Integration Tests. SITE integration means putting together various elements that are involved to bring forth an operational SITE experiment. Cluster Support Operations Plan will address all the portions that are involved in cluster support; to quote a few: power supplies, front-end units, cable assemblies, antennas, feeds, TV sets, transports, maintenance centers, SVC's, communication links to the SITEOCC and so on. Putting together these to give an effective Cluster System involves detailed planning and tests and these will be described in this cluster support SITE integration plan. In trouble-shooting and also to judge the adequacy of certain tests during integration, one may have to refer to component/assembly tests. For example, a front-end converter would have been tested well in the factory and typical signal, and voltage levels at important points would be described in acceptance test plans/procedures (or factory internal documents). These need not be repeated here for all these points during integration; only critical points in the interfaces need be monitored. For the SITE various such component/assembly test procedures and reports will be internal to the respective units. So, for the SITE experiment, in order to facilitate easy traceability of such test procedures/reports, as and when need arises, all such relevent test procedures/reports shall be quoted under the heading of Applicable Documents. As is needed for all test plans, equipment required, the criteria of acceptance, etc., will be indicated.

4.4.6.10 Simulation Tests to Demonstrate Pre-Drift Readiness. Before drifting the ATS-6 toward India, a readiness review will be done by ATS Project and SAC. To provide data base for such a review and subsequent decision, simulation tests will be performed at the clusters. Depending on the agreed simulation-equipment (whether it is the transponder simulator or something equivalent), the plan will describe the test, parameters measured, criteria used, etc., to ascertain pre-drift readiness. Any link calculation involved should be tabulated.

These simulation tests should involve VRS also, e.g., some simulated signals from the ground receive (860 MHz) antennas may be fed to VHF rediffusion transmitters and tested in VHF TV sets. Or some form of s/c simulator may be used.

4.4.6.11 STOP Maneuver Tests. When the s/c orbit is circularized and stopped at 35°E, it will be done as per the STOP plan generated by GSFC. Very soon, following this maneuver the DRS antenna will be pointed towards antennas as pre-planned or as instructed by the SITEOCC. The DRS will receive the ESCES generated signals and these tests will evaluate the link performance, s/c drift, etc. Link calculations as applicable should be written down for these.

4.4.6.12 SITE Operations Systems Checkout. This test plan will describe all tests required to evaluate operational adequacy and preparedness of the total SITE system before the start of SITE experiment and the portions involved for the clusters will be described here. Noting the fact that the SITEOCC is in control of the conduction of SITE experiment, these checkouts should be carefully coordinated with them. All link calculations, as applicable, should be written down for average and worst cases.

The SITE experiment is being conducted as a test bed for the development of a satellite based national TV system for India. Consequently, it is extremely important that the entire system employed for the conduct of this experiment be maintained at a peak level of performance to minimize the down time and to impact favorably on the viewer with respect to picture and sound quality. This also means that the entire cluster works in the best way possible, maintained and supported well. The power supplies, antenna pointing, etc., should be done well; so also the availability of maintenance personnel where need arises.

To evaluate such a preparedness before regular broadcasts begin, this test plan will spell out all the checkouts needed on operational elements: on all technical interfaces, communication links, administrative and logistic support, etc. The test plan and its execution will be the responsibility of the Cluster Support Manager(s); it is to be noted that the SITEOCC could have some overriding controls.

Once these tests are completed satisfactorily, the total SITE system is ready for demonstration to top India and U.S. officials

(e.g., Prof. Dhawan, Chairman, ISRO). After such a demonstration and review, regular broadcasts begin.

4.4.6.13 SITE Demonstration Tests. Essentially this plan describes the methods and means to demonstrate the readiness of the total SITE system for regular scheduled broadcasts to top officials in India and U.S. Once these demonstrations are successfully completed, the SITE system is ready for regularly scheduled broadcasts. All applicable link calculations for this test are to be referred. It should be noted that the particular DRS/VRS to be viewed, may be selected at random by the high officials.

4.4.6.14 Tests During Scheduled Broadcasts. The healthy operations of the SITE system just starts after system operations checkout and SITE demonstrations. This system needs to be maintained as a viable experiment.

The SVC, DRS, VRS and Limited Rebroadcast Stations should evolve some regular operational procedures. For example, villagers may be taught to put on TV receivers, see some signal indicators, select audio channels, put power supplies on charging mode after broadcasts, make simple observations on these, and so on. Some simple signal to noise tests may be done at SVC's on a regular or periodic basis. These tests, including simple observations by the villagers should be thought of, planned and brought out in this section. These data will be evaluated at the SITEOCC for the daily/periodic review of operations.

4.4.7 Cluster Data Management Plans

The data collected at the clusters in terms of technical performance, maintenance, power supplies performance and other logistics are one of the valuable data that will result from the SITE experiment; this will be very helpful in planning out future operational systems.

4.4.7.1 Data at Special Validation Clusters. Much of the data here will be useful for planning out future systems. One important set of data is the daily signal quality data sent to the SITEOCC; for the SITEOCC this set of parameters is daily needed to ensure optimization of operational procedures. The special validation clusters will conduct detailed tests on the DRS and also record the representativeness of the SVC to the nearby DRS's/VRS's.

Maintenance and other administrative books may be maintained here or offices nearby to SVC's. Records of performance of nearby DRS/VRS will all be stored here or nearby.

4.4.7.2 Data at Maintenance Centers. The regular data collection of number of repairs, type of repairs, etc., will be documented; many of the data that will be for long term analysis may be transferred to places as deemed necessary by ISRO. But for regular operational streamlining, the maintenance centers will evolve charts, and displays that will inform the status of nearby DRS/VRS; the most frequent failure/repair; method of access and so on. The viewpoint in evolving this is to help the management of cluster maintenance at utmost speed and efficacy.

4.4.7.3 Data Transfer. Most of data from cluster will be transferred by post or record books transferred by Jeeps/other transport. Except for few operational parameters from SVC's there is no need to transmit data from the clusters to SITEOCC by TTY or telegraph.

4.4.8 Cluster Support Operational Procedure for Scheduled Broadcasts.

The SITEOCC daily acquires the ATS-6 spacecraft after experiments over Europe and adjusts the power, pointing mode, etc., for optimizing the technical parameters for the SITE experiment.

4.4.8.1 SITE Broadcast Operations Plan. By the very nature of the DRS and VRS which will be left in villages/community centers, elaborate tune-up and antenna pointing methods will be self-defeating in purpose. Still some simple techniques such as turning on the TV sets, seeing some signal indicators, if any, selecting audio, etc., can be taught to the villages. Even slight adjustment of antennas where there could be disturbances due to winds is conceivable. Also the villagers/or responsible representatives from the village may be taught to check for some vital links daily whether cables are okay, power supplies okay and so on. Sometimes, batteries might have to be put on charge, etc. These details should be detailed depending on categories of villages — considering electrification, availability of skilled persons, weather conditions (monsoon, etc.) and so on. It is expected the technical design is such that these operations are minimum; but a careful thought should be given in spelling these out, including reporting system in case of problems so that most of the DRS/VRS will be operating at full efficiency during the SITE experiment.

4.4.8.2 Interface with the SITEOCC. Most of the information from DRS/VRS/LRS are processed from Operations viewpoint and the processed information reached the SITEOCC by post (mail). The management structure/system for this has to be defined. Only SVC's will have some direct contact with the SITEOCC to give information daily on selected operational parameters (e.g., signal quality) SVC's and associated DRS/VRS/LRS will be in touch through post (mail) and persons.

4.4.8.3 Interface with Logistic Supports. In order to maintain the clusters, it is necessary that the individual DRS/VRS/LRS be able to contact some maintenance centers in case of trouble for corrective actions. This is what is termed as logistic support and these details from the viewpoint of day-to-day operations should be developed here. Evolution of this system and its organization is essential to manage future systems that follow SITE. The speed and efficiency of service should be given utmost importance as also the cost elements.

4.5 SOFTWARE OPERATIONS PLAN

4.5.1 Functions

By software we mean here all the video tapes, films, slides or other real time signals that will be used for the SITE experiments. In some cases as applicable the "hardware" such as studios, projectors, etc., also come under purview of this. Many development processes that result in the film/tape production are not addressed here, as also the program content itself. Regular delivery of these software to the ESCES and back-up stations as per previously agreed schedules and providing for adequate build of stocks are very vital for the SITE experiments. The issue of broadcast schedules in advance and adherence to these as far as possible is one other important activity.

4.5.2 Organizational Chart

All India Ratio (AIR) and ISRO jointly are responsible for delivery of software. The interfaces between AIR and ISRO for the SITE experiment in terms of contact points, deliveries, reporting, etc., are delineated in the Organization Chart, Figure 4-11, listing key personnel.

4.5.3 Schedules

Detailed milestone charts showing all important development and operational activities done for software operations for the SITE experiment are shown in

Figure 4-12. The activities such as completion of test plans, reviews, etc., also are shown on these milestone charts.

4.5.4 Manpower Requirements

The manpower involved at AIR and ISRO for software operations for the SITE experiment is shown on Table 4-11; key trainees and their training period are also shown on these. Figure 4-13 describes the manpower loading on monthly basis at AIR and ISRO for software for the SITE experiment.

4.5.5 Reviews

All the main internal design and operations reviews held for SITE software, reviews held with other Indian units involved in the SITE experiment and/or NASA are spelled out in this section. Their date and the major actions and decisions that would result from these are to be tabulated as in Table 4-12.

4.5.6 Details of Test Plans

Many of the desired operations can be assured for the SITE experiment, only after performing sufficient tests on various subsystems and systems. These tests are to be carefully planned with the overall systems considerations in view. To ensure this, detailed test plans are generated for each test involved and these are reviewed and accepted by authorized personnel before performing tests.

NOTE

Many other units involved in SITE, such as ESD, SCSD, etc., also have similar tests, e.g. ESD and SCSD will also have test plans for SITE integration tests and they will address ESD, SCSD, etc., portions of it respectively. To avoid confusion, the titles should be Test Plan for Software SITE Integration Tests and so on. Also while giving numbers to these test plans AIR/SAC should ensure coordinated numberings to avoid confusion.

4.5.6.1 Program Material Delivery Tests. The program tapes/films/signals (in case real time transmission) should be tested for certain objective performance criteria before leaving their destination and also after receipt in respective Earth stations and/or the ESCES. These are spelled out in these plans with acceptance criteria, sign-off provisions, etc. This applies to regularly scheduled broadcast materials as well as test materials and back-up materials.

4.5.6.2 SITE Integration Tests. SITE integration means putting together various elements that are involved to bring forth an operational SITE experiment. Software Operations Plan will address all the portions that are involved in software operations: to quote a few, video tapes, projectors, signal lines, cameras, monitors and so on. Putting together these to give an effective system involves detailed planning and tests and these will be described in this software SITE integration plan. In trouble-shooting and also to judge the adequacy of certain tests during integration, one may have to refer to component/assembly tests. For example, distortion in test tapes. For the SITE various such component/assembly test procedures and reports will be internal to the respective units. So, for the SITE experiment, in order to facilitate easy traceability of such test procedures/reports, as and when need arises, all such relevant test procedures/reports shall be quoted under the heading of Applicable Documents. As is needed for all test plans, equipment required, the criteria of acceptance, etc., will be indicated.

4.5.6.3 SITE Operations System Checkout. This test plan will describe all tests required to evaluate operational adequacy and preparedness of the total SITE system before the start of SITE experiment and the portions involved in software will be described here.

The SITE experiment is being conducted as a test bed for the development of a satellite based national TV system for India. Consequently, it is extremely important that the entire system employed for the conduct of this experiment be maintained at a peak level of performance to minimize the down time and to impact favorably on the viewer with respect to picture and sound quality. This also means that broadcast adheres to published schedules insofar as possible, clusters be maintained well, the SITE Operations Control Center effectively coordinates all elements of the SITE experiment operations.

To evaluate such a preparedness before regular broadcasts begin, this test plan will spell out all the checkouts needed on operational elements: on all technical interfaces, communication links, administrative and logistic supports, etc. The test plan and its execution will be the responsibility of the person(s) identified by AIR and ISRO to conduct software operations. The tests specifically will check all operational interfaces electrical, administrative (mailing methods), information systems (such as

stock delivery indicators) and so on. Once these tests are completed satisfactorily, the total SITE system is ready for demonstration to top India and U.S. officials, (e.g., Prof. Dhawan, Chairman, ISRO). After such a demonstration and review, regular broadcasts begin.

4.5.6.4 SITE Demonstration Tests. Thus this plan should coordinate all elements of the SITE experiment. Essentially this plan describes the methods and means to demonstrate the readiness of the total SITE system for regular scheduled broadcasts to top officials in India and U.S. Once these demonstrations are successfully completed, the SITE system is ready for regularly scheduled broadcasts. All applicable link calculations for this test are to be referred.

4.5.6.5 Tests During Scheduled Broadcasts. The healthy operations of the SITE system just starts after system operations checkout and SITE demonstrations. This system needs to be maintained as a viable experiment. For the software delivery on a daily basis the program material objective technical parameters, etc., should be measured as also any links that are used to transmit these. For example, AIR station in Delhi which will have to transmit programs in the back-up mode will test its links to the Delhi Earth stations for distortion, linearity, etc. this applies both for transmission and reception for rebroadcast — at Srinagar, Bombay, Delhi, Anand, etc. Also regular periodic checks should be done of stocked items (some representative checks as applicable).

4.5.7 Software Data Management Plan

Most important data regarding software are broadcast schedules, the types of scripts and pictures shown, the preferences in the selection of software, technical data on these and so on.

4.5.7.1 Data Management Requirements at Studios. These will be essentially regarding the program material for SITE: the script, picture content, languages used in audio channels, duration of the program, how many times these were shown, stock position at other Earth stations and ESCES as applicable and technical details. Some such data should be made available at the studios in quick look form in case the SITEOCC wants to switch programs for operational or other considerations.

4.5.7.2 Data Management at Software Production Facilities. These are essentially the schedules and priorities required for the production of the SITE software.

4.5.8 Software Operational Procedure for Scheduled Broadcasts

The software facilities are to be ready on a regular basis for the SITE experiment. The final controlling authority of the schedules and programs for the SITE experiment will be the SITEOCC.

4.5.8.1 SITE Broadcast Operational Plan. Daily before regular broadcasts the SITEOCC will do certain checks on the total system to ensure proper operations. The SITEOCC plan for this is discussed in paragraph 4.2.8.1. The software related aspects should be elaborated in this section of Software Operations Plan (Vol. V). It should be in basic agreement with the SITEOCC document, which has overriding control over all other documents.

4.5.8.2 Interface to the SITE Control Center (SITEOCC). The checks and set up needed daily with the SITEOCC should be described here. For example, how the regular AIR studios inform the Earth stations about their readiness to start daily SITE operations and how this is informed to the SITEOCC and so on, should be described.

4.5.8.3 Interface to VHF Rediffusion Stations. In receive stations, which receive satellite UHF signals, have to recover the video and audio signal to transmit them to the regular AIR stations. This may involve routing through the studios. The tests on such links, procedures for such set up, etc., should be described here.

4.6 OPERATIONAL INTERFACE DOCUMENT

This describes many interfaces during the operation of the SITE experiment. To name a few are the interfaces with the ATSOCC and Madrid, interfaces between the SITEOCC and Madrid, dedicated telephone lines in India and so on.

4.6.1 Uses and Applicability

Some of the interfaces are described in detail in the other operations plans, for example, the ESCES plan will deal with the SITEOCC-Madrid link, the tests to be done on it, etc. Still in the SITE experiment, there are many interfaces that may not be described in detail in any of the five volumes of the Operations Plan. Hence, in order not to miss any interface, this document will collect all the

interfaces in a single document. As applicable, it may quote references to other volumes whenever details are available in those volumes. However all such interfaces should be mentioned in this. This document can thus be used by the Operation Managers as the vital interface document.

4.6.2 Organizations and Responsibilities.

Herein the organization for operations at both NASA and ISRO should be described and also as to how they will interface to coordinate the SITE experiment operations (see Figure 4-14). The responsibilities for assuring the interfaces mentioned herein are shared by the ATS Mission Operations Managers and the SAC Operations Manager. Details are tabulated in Table 4-13. These will be continually updated to reflect the latest understanding between the two.

4.6.3 ISRO Interfaces with Other Agencies in India

For the successful completion of the SITE experiment participation by many agencies of India is required. For example, All India Radio (AIR) provides many software facilities; Communications Ministry provides for many internal communication links; many VHF rediffusion receivers will be owned by local government agencies or private bodies and so on. All these various participating agencies/organizations should be brought together for the SITE experiment operations; as noted above the interfaces will be technical and/or administrative. In this section (Vol. VI) all such interfaces should be identified and also the methods by which the interfaces will be kept operational. For example, how the microwave or telephone line facilities will be rented or leased, how and when the agreements will be entered into for these, the agencies with which such coordination will be done, etc., should be described. Should the interface be administrative, this should describe the agencies involved, type of agreement, the functions that will be covered and so on.

4.6.4 Reviews and Action Item

Many reviews will be held during the build-in phase of SITE experiment and after the experiment starts. Reviews regarding operational aspects are dealt with in Vol. II through V for their respective areas. However this SITE Operational Interface Document (SOID) should list all the reviews involved in SITE operations and list them as in Table 4-14. The action items that result from such reviews should be tracked by ATS Mission Operations Manager and SAC Operations Manager. This list in SOID will be the overall controlling document for reviews related to the SITE operations.

4.6.5 Schedule Control

The time element of various events is an important factor in successful completion of the SITE operations. This is monitored by the top document called SITE Operations Schedule and associated PERT Chart; many lower level schedules and PERT Charts are needed to monitor many detailed activities. For example, deployment of receivers and antennas in DRS may have one detailed document of its own for scheduling and associated PERT Chart. All such sublevel detailed schedules/PERT should be quoted here with a brief note as to the functions covered by them. Respective manager/officers of NASA/ISRO will be the monitoring/controlling authorities of these schedules and events; however, a complete listing of schedule related documents is needed to have traceability of critical patterns and corrective actions, should the need arise.

4.6.6 Budget Considerations

The budget tracking is also one very vital action for the operations. This however will be done internally. A mention however will be made of responsible authorities who will do it.

4.6.7 Trainees and Representatives

For the SITE operations there may be requirements of trainees and deputation of representatives from NASA/ISRO. For example, when the TTY link set up between Madrid and Ahmedabad, an Indian operator will be sent for a few days to use the NASCOM standard equipment. Details for this are to be tabulated in Table 4-15 with the type of training, approximate duration of training and the calendar period during which it should be accomplished. The same table should also mention about India/U.S. representatives, their duration of stay and calendar months.

4.6.8 Test Plans Approval

Various Test Plans — top level documents and lower level documents — are generated for the SITE operations. Examples are Cluster Hardware Production Acceptance Test Plans and the lower level documents related to it such as Production Acceptance Plans for chicken mesh antennas, front-end converters, etc. All such top and lower documents as applicable to the SITE operations should be listed and the agencies involved in approval of these should be described. See Table 4-16. The completion dates for these can be monitored from the schedule section references.

4.6.9 Documentation and Data Management

This is also an important function of the SITE operations. This should specify how the overall control of the documentation will be accomplished, that is, as to how finally accepted versions of plans and schedules, etc., will be identified, released and updated. NASA and ISRO should identify a person/office that will do this function for the SITE. The ATS Mission Operations Manager and the SAC Operations Manager should have very close contact and control over these documentations for the SITE operations. This documentation will cover all the technical/administrative data, plans, schedules, etc.

4.6.10 Communication Links from India to NASA Stations

This will be described in great detail in Vol. II (ESCES Operations Plan). However for satisfactory monitoring of such interfaces SOID should briefly describe it and refer to relevant paragraphs of Vol. II and other related documents for a complete picture.

4.6.11 Ranging, and Orbit Evaluation

The methods of ranging during the SITE experiment will be described in Vol. II (see also paragraphs 4.2.6.8 and 4.2.6.10 of the present document). This however describes only the technical portions of s/c transponder and ATS R equipment. This can be repeated or elaborated upon.

Besides this should describe the methods of orbit computations, assumptions and accuracies involved, etc.

It should also specify as to whether the data will be processed at ESCES, Ahmedabad or will be done at ATSOCC and so on.

The frequencies with which ranging will be done, etc., also should be detailed.

4.6.12 Beam Center or Nagpur Station

This is described in earlier sections of the present document (paragraph 3.3.1.2.8). Essentially it serves as a back up to s/c pointing in case of malfunction of s/c ACS. It is understood during this writing that the beam center has been shifted slightly westward. This term Nagpur station applies to the Beam Center Station which will house the C-band beacon (for interferometer) S-band, and/or VHF - monopulse beacons.

This section of the SOID should describe the detailed specifications of this station as well as its functions, organization, etc.

4.6.13 Communication Links within India

There are many links within India needed for the SITE operations. Examples are links between studios and Earth stations/ESCES, links between the SITEOCC and Indian Earth stations and so on. These are described in various portions of Vol. II, Vol. III, etc., (see 4.3.6.2, 4.3.8.2, 4.3.8.3, 4.4.8.2, etc.) of the present document). However all these scattered information will be brought together in the SOID. It will in addition cover all the interfaces not covered earlier. Links such as telegraph lines between SAC and AIR, etc., also will be mentioned for completion. This section of the SOID should list all these links and name the agency that will supervise/maintain them. For detailed technical specifications and tests on these, reference may be made to the other volumes or documents. This listing of all communication links and responsible agencies in one single document will be helpful for smooth control of the SITE operations by the SITEOCC.

4.6.14 Power Sources to Clusters and Limited Broadcast Stations

This section of the SOID should describe the power sources utilized in all the DRS's, LRS's and VRS's, their power capacity, period of maintenance (such as recharging, etc.), the maintenance centers to which these sources are affiliated and so on. For the technical details reference may be made to other documents. But this listing should be complete enough to give an overview of all types of power sources at various clusters. For example under the heading of Rajasthan all the villages with the types of power sources should be listed, and so on for other stations. See Table 4-17.

4.6.15 Logistic Supports to Clusters and Limited Rebroadcast Facilities

This section of the SOID deals with the administrative supports, road facilities, transport arrangements, methods of contacting the maintenance centers from DRS and VRS in case of troubles, special facilities at SVC's, etc. All these activities as related to the SITE operations should be described here. Some typical example should be illustrated for each aspect (administrative, transport, etc.)

4.6.16 Operations of Maintenance Centers and Calibrations

Maintenance of all the field TV receivers, transmitters and communication links is an important activity. It will be both repair-type maintenance and preventive maintenance.

Calibration of the field receivers, power sources, etc., are to be done to have reliable data for objective evaluation.

All these aspects, the period at which calibration and preventive maintenance will be done, the turn-around time required for repairs, the equipment used at maintenance centers, personnel, etc., should be discussed here.

Though the Earth stations, ESCES, studios, links, etc., will have their own maintenance procedures, these should be quoted here and brief description of these should be given.

The intent of this is to have a good maintenance and calibration plan for all the SITE elements at a single place to give a complete overview.

4.6.17 SITE Technical Evaluation Plan

This is to be done very carefully considering all the technical parameters that are involved in deploying an operational satellite based instructional TV system; the data and evaluation resulting from the SITE will be useful in planning for the future operational systems not only in India but also for other countries in the world.

Bearing this in mind, all technical parameters should be carefully selected for evaluation. Such a selection is thus necessarily will be from many sources including the persons involved in the SITE operations. The SOID will list all these parameters, so that the persons planning the SITE operations will not overlook or miss any technical parameter from data collection. Thus, the ATS Mission Operations Manager and the SAC Operations Manager, who have the responsibility for the SOID and who use the SOID to ensure operation of all interfaces, should carefully oversee all the SITE operations and test plans so that they carry out this important aspect of data collection for the SITE technical evaluation.

Only a listing and brief descriptions of tests are needed in the SOID; for the details it can refer to relevant documents or a separate document called SITE technical evaluation plan which may be generated elsewhere.

4.6.18 SITE Social Evaluation Plan

This is another important objective of the SITE experiment. The salient parameters for this will be listed in the SOID to have adequate guidelines in planning the SITE operations, which have to serve these objectives too. Separate plan(s) will exist for detailing these aspects of social evaluation, and these documents will be quoted here.

5.0 OTHER RELATED DOCUMENTS

This listing is done mainly for ease of reference. Some of these documents will have controlling influence on the overall SITE system and hence on the operations plans too.

1. 862-0001 — Spacecraft System Specification for ATS-F&G
2. 862-3000 — Communication Subsystem Specification for ATS-F&G
3. 862-2000 — Telemetry & Command Subsystem Spec for ATS-F&G
4. Interferometer Subsystem Specification for ATS-F&G
5. Transponder Simulator Specification for ATS-F&G
6. Ground Station Specification for ATS-F&G
7. Specifications for the Hardware for SITE by ESD, ISRO
8. SCSD Specifications for the Earth Stations
9. ESCES Specifications for the SITE, and so on.

Presently this list is incomplete; subsequent reviews should complete this and many documents from ISRO and other Indian Agencies should be listed here reflecting the latest revision(s).

6.0 LIST OF ACRONYNS

In this current volume no attempt has been made to arrange these in alphabetical order as many will get added/deleted in reviews by various parties concerned. However most of them are listed for convenience and preserve a format for future revisions.

ATS	Applications Technology Satellite
SITE	Satellite Instructional Television Experiment
AIR	All India Radio
SAC	Space Applications Center
GSFC	Goddard Space Flight Center

NASA	National Aeronautics & Space Administration
ISRO	Indian Space Research Organization
DAE	Dept. of Atomic Energy
DRS	Direct Reception Stations
SVC	Special Validation Clusters
VRS	VHF Rediffusion Stations
LRS	Limited Rebroadcast Stations
SOID	SITE Operational Interface Document
ESD	Electronics & Systems Division
SCSD	Satellite Communication Systems Division
ESCES	Experimental Satellite Communication Earth Station
ATSOCC	ATS Operations Control Center
SITEOCC	SITE Operational Control Center
ETV	Educational Television
TGS	Transportable Ground Station
ECH	Earth Coverage Horn
ACS	Altitude Control Subsystem
CSS	Communication Subsystem
IGS	Indian Ground System
s/c	Spacecraft
T&CS	Telemetry & Command Subsystem
TRUST	Television Relay Using Small Terminals

7.0 SOME IMPORTANT ADDRESSES

Some important addresses of people related to the SITE experiment are listed here and should be continually updated reflecting the latest changes.

(1) Prof. E. V. Chitnis
Program Manager, SITE
Space Applications Center, ISRO
2nd Floor Sahajanand College
Ahmedabad 380 015 (India)

Office Phone:
Telex:
Home Phone:

(2) Dr. A. M. G. Andrus
Code ECC, NASA Headquarters
Independence Avenue
Washington, D.C.
U.S.A.

Office Phone:
Telex:
Home Phone:

(3) A. H. Sabelhaus
ATS Spacecraft Manager
(Project Manager SITE)
Code 460
Goddard Space Flight Center
Greenbelt, Maryland 20771
U.S.A.

Office Phone:
Telex:
Home Phone:

(4) E. E. Metzger
ATS Mission Operations Manager
Code 460
Goddard Space Flight Center
Greenbelt, Maryland 20771
U.S.A.

Office Phone:
Telex:
Home Phone:

(5) J. E. Miller
Head, Communications Division
(Principal Investigator SITE)
Code 751
Goddard Space Flight Center
Greenbelt, Maryland 20771
U.S.A.

Office Phone:
Telex:
Home Phone:

(6) J. M. Thole
ATS Project Manager
Code 460
Goddard Space Flight Center
Greenbelt, Maryland 20771
U.S.A.

Office Phone:
Telex:
Home Phone:

(7) H. L. Galloway
SITE Coordinator, (GSFC)
Code 460
Goddard Space Flight Center
Greenbelt, Maryland 20771
U.S.A.

Office Phone: (301)-982-2859
Telex:
Home Phone:

(8) Y. S. Rajan
ISRO Representative
Code 460, ATS Project
Goddard Space Flight Center
Greenbelt, Maryland 20771
U.S.A.

Office Phone: (301)-982-2880
(301)-982-2601
Telex:
Home Phone:

(9) Prof. Yash Pal
Director, Space Applications Center
2nd Floor, Sahajanand College
Ahmedabad 380 015 (India)

Office Phone:
Telex:
Home Phone:

(10) S. R. Thakore
Dy Director (Admin.)
Space Applications Center, ISRO
2nd Floor, Sahajanand College
Ahmedabad 380 015 (India)

Office Phone:
Telex:
Home Phone:

(11) K. S. Karnik
SITE Software Systems Manager
Space Applications Center
2nd Floor, Sahajanand College
Ahmedabad 380 015 (India)

Office Phone:
Telex:
Home Phone:

(12) Col. L. Pant
Director, ESCES
Post Bag 11
Navrangpura
Ahmedabad 380 009 (India)

Office Phone:
Telex:
Home Phone:

(13) Dr. B. S. Rao
Director, ESD

(14) Wg. Cdr. K. R. Rao
Director, SCSD

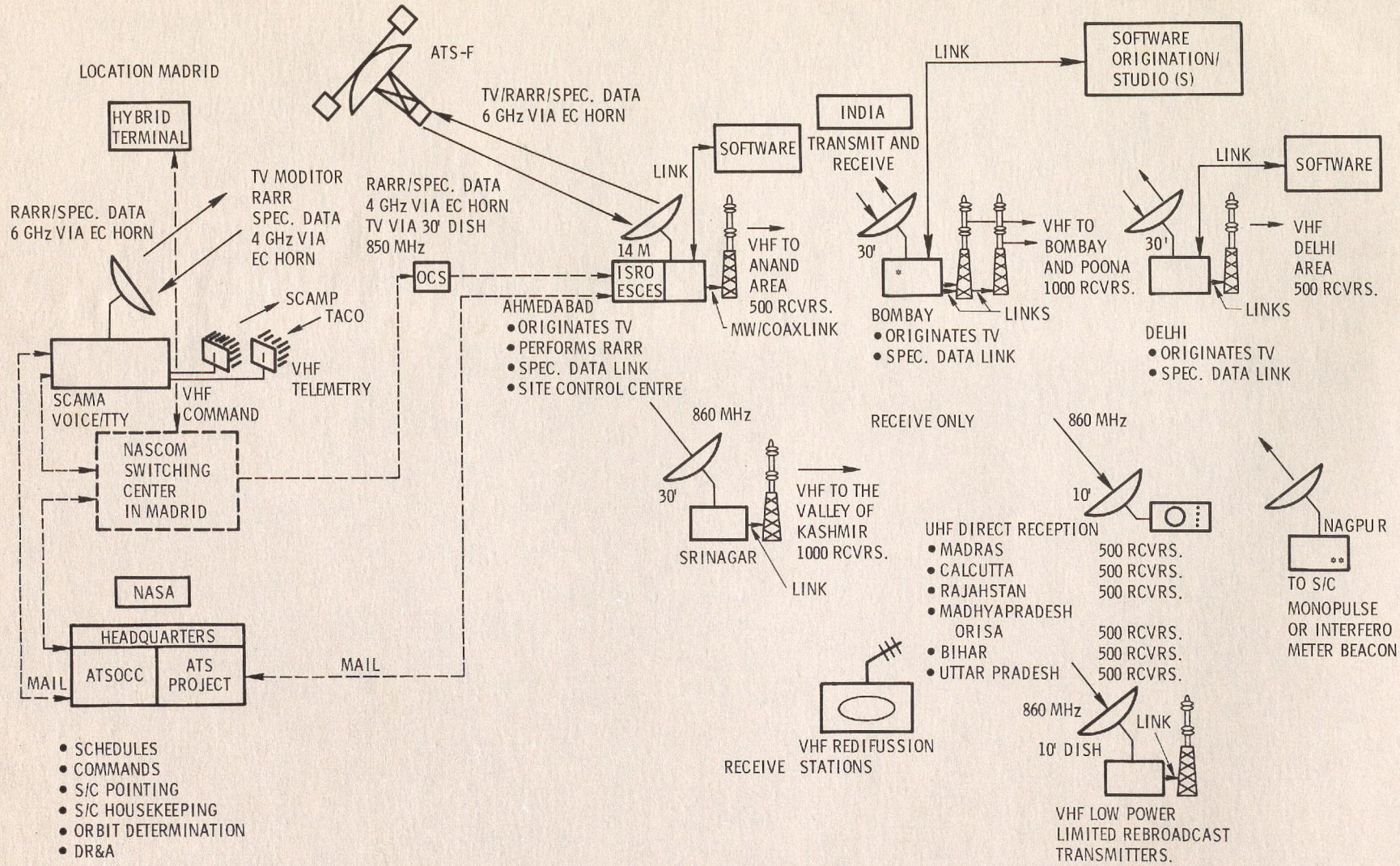
(15) K. L. Sondhi
Director, AVID

(16) P. P. Kale
Technical Adviser, SITE
Space Applications Center
2nd Floor, Sahajanand College
Ahmedabad 380 015 (India)

Office Phone:
Telex:
Home Phone:

(17) Romesh Chandar

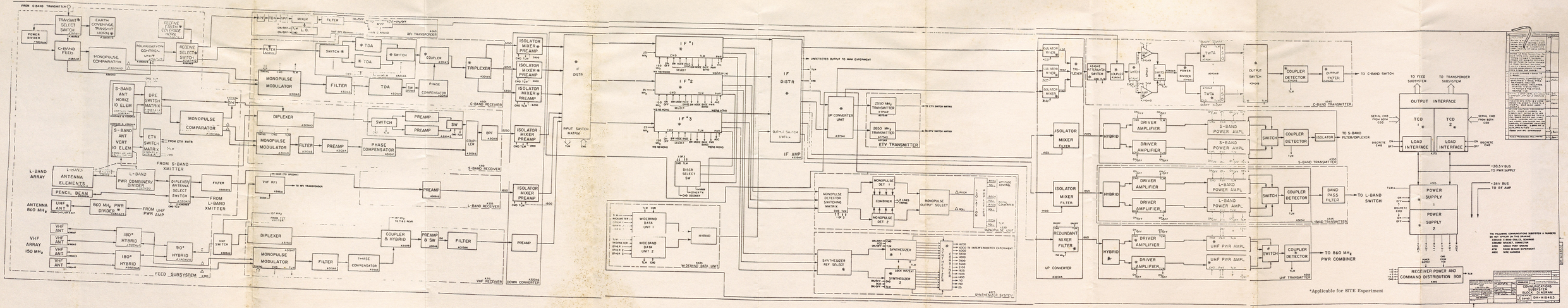
(18) Incomplete



* BOMBAY STATION HAS BEEN DROPPED AT THE TIME OF PRINTING THIS REPORT

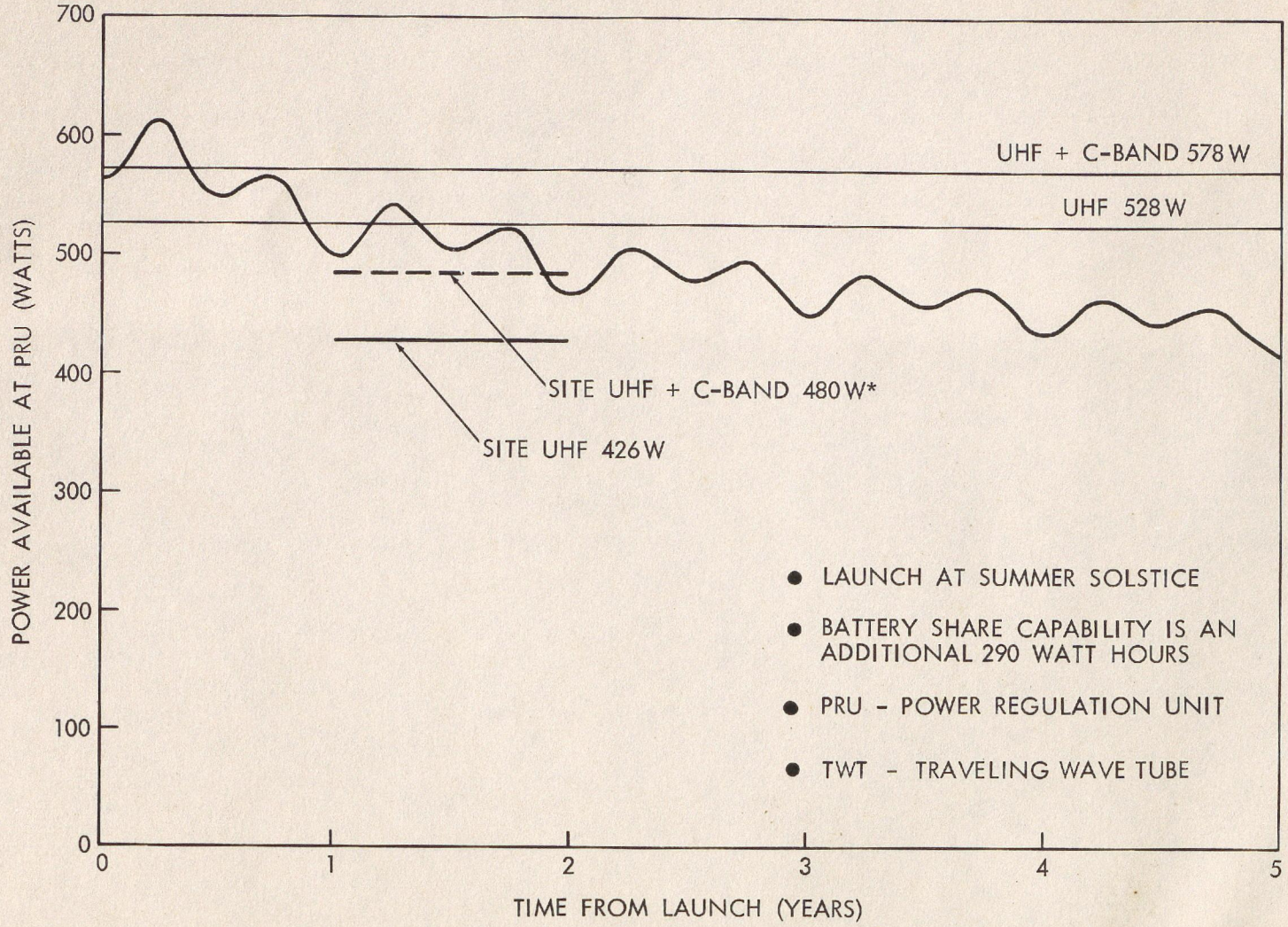
** NAGPUR MAY NOT BE THE EXACT BEAM CENTER. THIS STATION WILL BE WHEREVER BEAM CENTER IS.

FIGURE 2-1. SITE EXPERIMENT FACILITIES AND LINKS



*Applicable for SITE Experiment

Figure 3-1. Communications Subsystem Block Diagram



*ONE TWT

Figure 3-2. Solar Array Capabilities

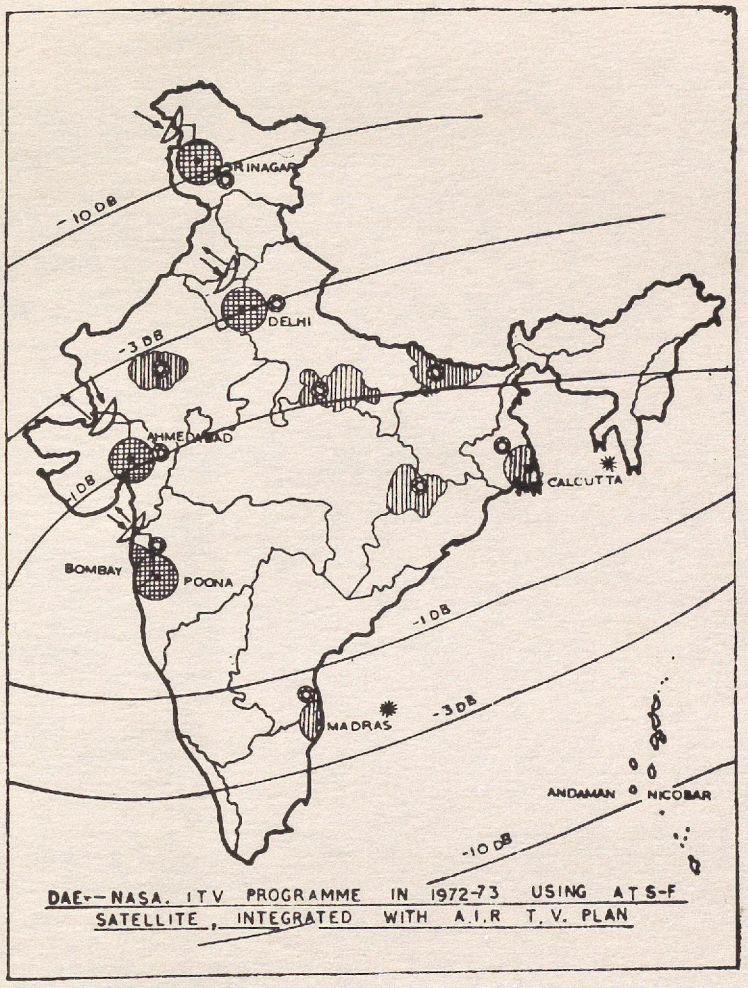


Figure 3-2a. Map of India Showing Clusters (Sarabbai) (Note: Clusters Shown Here are Indicative; Latest Selection Will Be Shown in Future Revisions.)

Clusters using Rediffusion TV at V.H.F.

Clusters using Direct Broadcast TV at 860 MHz with about 500 Community Receivers each

Transmit — Receive Satellite Earth Terminal

Receive only Satellite Earth Terminal

Programming Centers

To be converted to Rediffusion TV

NOTE: This figure should be updated.

The following figures will be drawn in India, explaining the items mentioned in applicable paragraphs of this operations plan:

Figure 4-1 Organization Chart of ESCES for the SITE

Figure 4-2 Milestone Chart for ESCES for SITE

Figure 4-3 Manpower Loading Chart of ESCES for the SITE

Figure 4-5 Organization Chart of SCSD for the SITE

Figure 4-6 Milestone Chart for SCSD for the SITE

Figure 4-7 Manpower Loading Chart of SCSD for the SITE

Figure 4-8 Organization Chart for Cluster Support for the SITE

Figure 4-9 Milestone Chart for Cluster Support for the SITE

Figure 4-10 Manpower Loading Chart for Cluster Support for the SITE

Figure 4-11 Organization Chart for the Software for the SITE

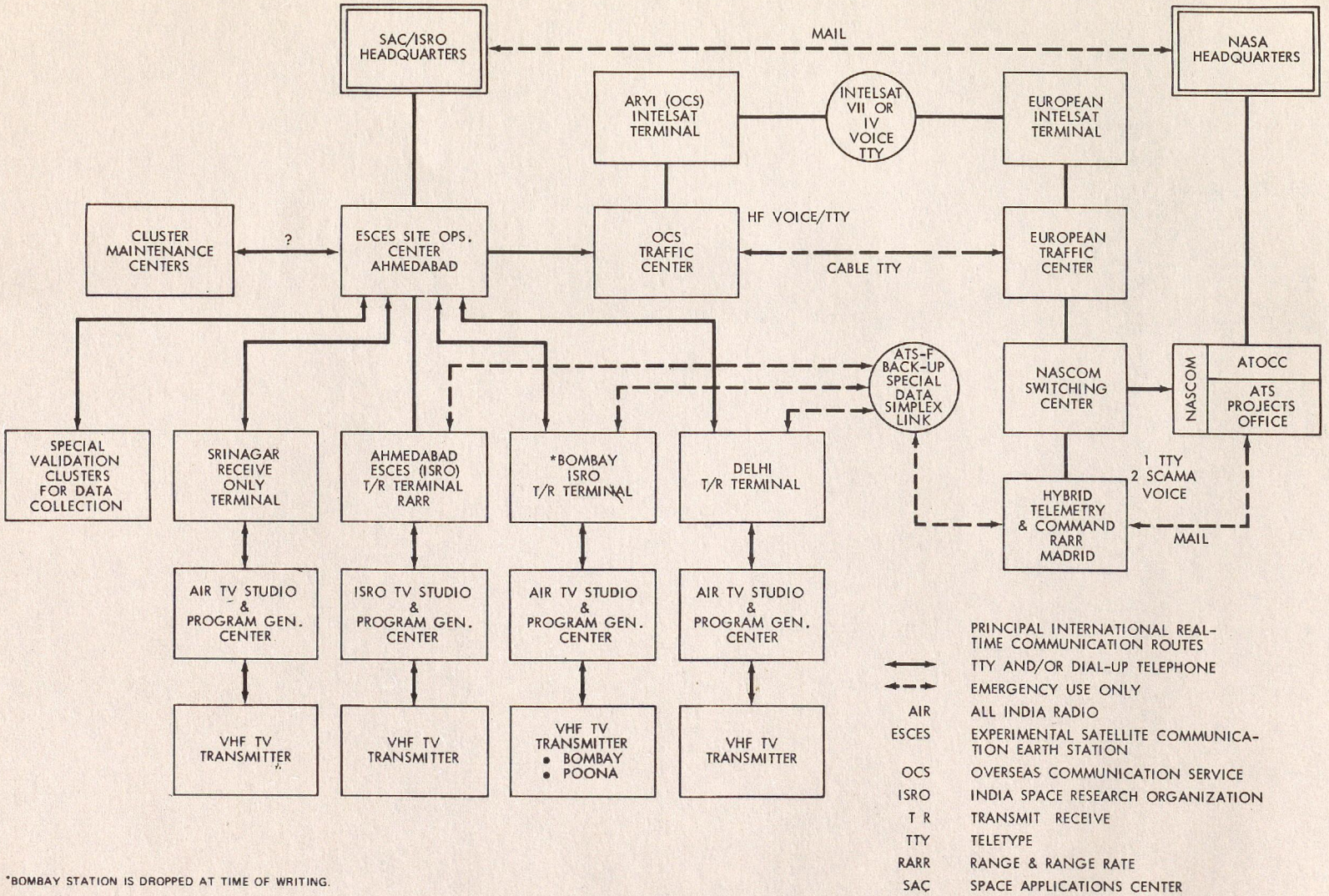
Figure 4-12 Milestone Chart for Software for the SITE

Figure 4-13 Manpower Loading Chart for Software for the SITE

The following figure is to be jointly evolved between ISRO and NASA:

Figure 4-14 Organization Chart for ISRO & NASA for SITE Operations and Interfaces.

The NASA portion will be prepared later and supplied; ISRO is to prepare its part. The interfaces are to be worked out with both these charts.



*BOMBAY STATION IS DROPPED AT TIME OF WRITING.

Figure 4-4. SITE Experiment Communications Plan

Table 3-1

Transponder Subsystem for SITE Performance Summary

	C-band		UHF
	Horn	Dish	Dish
Receive			
Receiver frequencies MHz	5950	5950	—
	6150	6150	—
	6350	6350	—
G/T db/°K			
Peak	-17	13.5	
Field of view	-20	10.5	
	(over 20°)	(over 0.4°)	
Polarization	Linear	Linear	
Axial ratio	25 db	25 db	
Transmit			
Transmitter frequencies MHz	3750	N.A.	860
	3950	N.A.	
	4150	N.A.	
EIRP dbw			
Peak			51
Field of view	25	N.A.	48
	(over 20° × 13°)		(over 2.8°)
Polarization	Linear	N.A.	RHCP
	(orthogonal to receiver)		(IRE)
Axial Ratio	25 db	N.A.	2.5 db
Beacon Frequency	Transmit freq. +30 MHz ±1.75 MHz	N.A.	890 MHz
Beacon EIRP (Nominal) dbw	0	N.A.	?

Table 3-2
Command System Characteristics

Modulation: PCM/FSK/AM/FM at VHF
PCM/FSK/AM/FM at C-Band

Frequencies: 154.20 MHz, Prime
148.26 MHz, Standby
C-Band, Switchable Backup

Antennas: 2 solar panel omnidirectional;
VHF prime focus feed;
C-Band earth coverage horn

Characteristic	COMMAND MODE	
	Normal & Command & Execute	GAC Command
Verification	Ground, via TM	Decoder address & parity
Execute	Digital Command	Execute as received
FSK tones	Logic "0" 7296 Hz Logic "1" 7808 Hz	Logic "0" 8700 Hz Logic "1" 11,900 Hz
Bit Rate	128 bps	1200 bps
Decoder address	9 bits	7 bits
Frame length	28 bits	13 bits
Discrete commands	512	---
Data word addresses	45	---
Data word length	9	---
ACS Configuration addresses	---	32
Normal Command	a) Execute and clear	High speed execute
Execute options	b) Execute and hold	of normal command
Execute pulse width	a) 56 ms, nominal b) 253 ms, nominal	11 ms, nominal

Table 3-2 (Continued)

Characteristic	COMMAND MODE	
	Normal Command & Execute	GAC Command
Max. Command Rate	2.2/sec for 56 ms commands, 1.4/sec for 253 ms commands, any rate up to 1.4/sec for either pulse width, none between 1.4/sec and 2.2/sec. All rates without ground verification	92.3/sec
Max. Repetitive Execute Rate	4.6/sec for 56 ms commands, 2.1/sec for 253 ms commands, any rate up to 2.1/sec for either pulse width; none between 2.1/sec and 4.6/sec.	44.5/sec (HSE Mode)
Time duration command resolution	253 ms	11 ms
Command Distribution	a) Array for support subsystem b) Dedicated to experiments c) Remote distributor for transponder	Dedicated to ACS only
Redundancy	Redundant antennas, receivers & decoders	Redundant, antennas, receivers, & decoders

Table 3-2 (Continued)

TELEMETRY PARAMETERS

CHARACTERISTICS	ATS F&G
FREQUENCIES	136.23 MHz, 137.11 MHz
SPACECRAFT ANTENNAS	NEAR OMNIDIRECTIONAL MOUNTED ON SOLAR PANELS. DIRECTIONAL VIA PRIME FOCUS FEED AND PARABOLIC REFLECTOR.
MODULATION	PCM/PM ON OMNI-ASSOCIATED TRANSMITTERS, PCM/FM/PM OR PM ON PRIME FOCUS FEED - ASSOCIATED TRANSMITTERS.
FORMATTING	FIXED FORMAT WITH DWELL CAPABILITY DATA FORMAT MANCHESTER II +180
BIT RATE	391 BPS NOMINAL.
WORD LENGTH	9-BITS
MINOR FRAME LENGTH	128 WORDS
MINOR FRAME PERIOD	APPROXIMATELY 3 SECONDS
SUBCOMMUTATION	LAST 16 WORDS, 16 WORDS DEEP
TOTAL FORMAT CAPACITY	368 NINE-BIT WORDS. EACH WORD CARRIES ONE DIGITIZED ANALOG TELEMETRY POINT OR NINE DIGITAL TELEMETRY POINTS.
ANALOG CHANNELS	276
DIGITAL CHANNEL (BITS)	783 (87 NINE BIT WORDS)

Table 3-3. Power Subsystem Characteristics

The power subsystem capability is shown below:

Battery power available to loads: 290 watt- hours (50% DOD/battery)

Solar array power (watts):

	Years	0	1	2	5
a	Equinox	645	550	510	450
b	Summer solstice +4° offset pointing	560	490	460	415

Solar array/battery share mode at end of 2 yrs. (watts):

	Hours	2	3	4
a	Equinox	655	610	585
b	Summer solstice +4° offset pointing	605	560	535

Power is provided for the spacecraft subsystems at the following bus voltages:

a. 30.5 ±2% at the power control unit output for use by spacecraft subsystems.

b. 28 ±2% at the power control unit output for use by the communication subsystem.

Solar Array—Pertinent facts on the mechanical configuration of the array are below:

Number of cells	21,600	Number of panels	32
Number of parallel cells per string	3 (2 cm x 4 cm)	Mechanical area	216 sq ft
Number of series cells per string	75	Solar cell area	186 sq ft
Number of strings	96	Packaging efficiency	80%

The solar array output power is a nominal 600 watts initially decreasing to a nominal 485 watts after 2 years.

Each solar array panel contains 675 solar cells which have the following characteristics:

1. N/P silicon
2. 2 cm x 4 cm
3. 2 ohm per cm nominal resistivity
4. 11.0% minimum average efficiency
5. 12 mil thickness

Table 3-4. ACS Characteristics

Item/Mode	Functions/Descriptions
Acquisition Mode	• Rate damping • Sun acquisition • Earth acquisition • Polaris acquisition
Operational and Experimental Mode	• Reference orientation (local vertical) • Pointing (offset from local vertical) • Slew/antenna pattern maneuvers • Station nulling (interferometer and monopulse) • Satellite tracking • Low jitter • Self-adaptive precision pointing spacecraft attitude control (SAPPSAC) • Orbit control (repositioning and stationkeeping)
DOC or ABC	• Primary logic functions of ACS
DOC (Digital Operations Controller)	• Accepts a wide variety of sensor inputs, solves control laws and commands torquers for all modes • Executes acquisition logic to acquire the sun, earth, and Polaris • Accepts commands for offset pointing (angle and ground coordinate commands) • Computes compensations required for pointing commands to account for orbit eccentricity, orbit inclination, and Polaris diurnal motion • Computes commands for performing Z-axis tracking of a low altitude satellite based on transmitted ATS and satellite ephemeris data • Computes commands for performing slew maneuvers for antenna pattern measurements • Provides a self-test routine within the DOC.
ABC (Analog Backup Controller)	Uses inputs from: • Earth sensor analog outputs (roll and pitch) • Polaris sensor (yaw, both units) • Rate gyros (analog rate outputs for rate damping) • Coarse sun sensor and fine sun sensor (pitch and yaw) • C-band, S-band, and VHF monopulse (roll and pitch)

Backup Capability—Operational			
Sensors		Controllers	Torquer
Roll/Pitch	Yaw		
Earth sensor	Polaris sensor 1	Digital operational controller 1	Wheels
Interferometer	Polaris sensor 2	Digital operational controller 2	SPS 2
Monopulse (C, S, VHF)	Digital sun sensor		SPS 1
Earth sensor	Polaris sensor 1	Analog backup controller	SPS 1
Monopulse (C, S, VHF)	Polaris sensor 2		SPS 2 Wheels
Earth sensor	Polaris sensor 1	Ground computation and command	Wheels
Interferometer	Polaris sensor 2		Wheels
Monopulse (C, S, VHF)	Interferometer Digital sun sensor		SPS 1 SPS 2

Table 3-5

Summary of Indian Earth Terminal Characteristics - Tentative

	Ahmedabad	Bombay	Delhi	Srinager
Antenna Diameter	45 foot	30 foot	30 foot	30 foot
Transmit Gain @ C-band (min)	55.5 db at 6.3 GHz	TBD	TBD	NA
Transmit Power (nominal)	5kw	TBD	TBD	NA
Receiver gain (min)				
C-band	52.3 db at 4.2 GHz	TBD	TBD	NA
UHF	TBD	TBD	TBD	TBD
Receive System noise temperature (max)				
C-band	130°K	TBD	TBD	NA
UHF	TBD	TBD	TBD	TBD
*UHF Received baseband signal to weighted noise ratio	TBD	TBD	TBD	TBD
Transmit frequencies C-band	5950/3950/6350 MHz	TBD	TBD	NA
Receive frequencies C-band	3750/3950/4150 MHz	TBD	TBD	NA
UHF	860 MHz	860 MHz	860 MHz	
	Right circular polarization (IRE)			

*Assumes s/c located at 35°E. Does not include the effect of man-made noise or sun in the field of view of the UHF antenna.

NOTE: With the s/c UHF beam pointed at the center of India, Srinagar is at about -8 db on the s/c antenna pattern. Note that the s/c axial ratio is not specified beyond the -3 db points and hence some additional losses in the receive antenna have to be taken into account.

To be updated in India.

The following tables are to be generated/completed in India, listing the items mentioned in applicable paragraphs of this operations plan:

Table 4-1	Manpower Requirements at ESCES for the SITE
Table 4-2	Reviews Involving ESCES/at ESCES for SITE
Table 4-6	Manpower Requirements for SCSD for the SITE
Table 4-7	Reviews Involving SCSD/at SCSD for SITE
Table 4-9	Manpower Requirements for Cluster Support for the SITE
Table 4-10	Reviews Involving Cluster Support Group/of Cluster Support Group for the SITE
Table 4-11	Manpower Requirements for Software for the SITE
Table 4-12	Reviews Involving Software/or Software for SITE
Table 3-6	Description of Studios in Ahmedabad, Bombay and Delhi
Table 4-17	List of Power Sources at Direct Reception Clusters and for Rediffusion Receive Sets

The following tables are to be jointly evolved by ISRO and NASA; these will be later added to this plan, in revisions.

Table 4-13	Responsibilities of ATS Mission Operations Manager & SAC Operations Manager
Table 4-14	List of Reviews for SITE Operations
Table 4-15	Trainee Requirements for SITE Operations
Table 4-16	List of Test Plans Applicable to the SITE Operations

Table 4-3

Test Schedules

	Short Title	Approx. Time Required (min)	Pre-Broadcast	Broadcast	Diagnostic and Maintenance
	Daily				
A	RF Signal Power	5	X		
B	RF Signal Power Variations (continuous)		X	X	
G	Video Gain Stability	5	X		
K	Test Pattern	5	X		As
P	Audio Gain Stability	5	X		And
	TV Broadcast	240		X	
	Weekly				When
C	Overall Linearity	5	X		Required
D	Group Delay	30	X		
E	Signal to Noise Ratio	7 ea Demod	X		
F	Video Differential Gain	15	X		
H	Video Low Response	3	X		
I	Video Transient Response	10	X		
J	Video Noise	30	X		
L	Video Baseband Response	20	X		
M	Audio Crosstalk	45	X		
N	Audio Response	20	X		
O	Audio Idle Noise	10	X		
Q	Audio Distortion	10	X		
	RARR	24 hours as and when required			

Table 4-8

	Short Title	Approx. Time Required (min)	Pre-Broadcast	Broadcast	Diagnostic and Maintenance
	Test Schedules				
	Daily				
A	RF Signal Power	5	X		
B	RF Signal Power Variations (continuous)		X	X	
G	Video Gain Stability	5	X		
K	Test Pattern	5	X		As
P	Audio Gain Stability	5	X		And
	TV Broadcast	240		X	
	Weekly				When
C	Overall Linearity	5	X		Required
D	Group Delay	30	X		
E	Signal to Noise Ratio	7 ea Demod	X		
F	Video Differential Gain	15	X		
H	Video Low Response	3	X		
I	Video Transient Response	10	X		
J	Video Noise	30	X		
L	Video Baseband Response	20	X		
M	Audio Crosstalk	45	X		
N	Audio Response	20	X		
O	Audio Idle Noise	10	X		
Q	Audio Distortion	10	X		