GOES N
Data Book

Prepared for

National Aeronautics and Space Administration

Goddard Space Flight Center

Greenbelt, Maryland 20771

Pursuant to

Contract NAS5-98069

Rev B

February 2005

CDRL PM-1-1-03

This page left blank.

Contents

Foreword

The multimission Geostationary Operational Environmental Satellite (GOES) program is a key element in National Oceanic and Atmospheric Administration (NOAA) operations. GOES weather imagery and quantitative sounding data offer a continuous and reliable stream of environmental information used to support weather forecasting, severe storm tracking, and meteorological research. Evolutionary improvements in the geostationary satellite system since 1974 (i.e., since the first Synchronous Meteorological Satellite, SMS-1) have been responsible for making the current GOES system the basic element for U.S. weather monitoring and forecasting. Spacecraft and ground-based systems work together to accomplish the GOES mission.

GOES N-P will aid activities ranging from severe storm warnings to resource management and advances in science. GOES N-P data will add to the global community of knowledge, embracing many civil and government environmental forecasting organizations that work to benefit people everywhere and help save lives.

Designed to operate in geosynchronous orbit, 35,790 km (22,240 statute miles) above the equator, thereby remaining stationary relative to the earth's surface, the advanced GOES N–P spacecraft continuously view the continental United States, neighboring environs of the Pacific and Atlantic Oceans, and Central and South America. The three-axis, body-stabilized spacecraft design enables the sensors to "stare" at the earth and thus more frequently image clouds, monitor earth's surface temperature and water vapor fields, and sound the atmosphere for its vertical thermal and vapor structures. Thus the evolution of atmospheric phenomena can be followed, ensuring real-time coverage of short-lived dynamic events that directly affect public safety, protection of property, and ultimately, economic health and development. The GOES N–P series of spacecraft are the principal observational platforms for covering dynamic weather events and the near-earth space environment for the first decade of the 21st century. These advanced spacecraft enhance the capability of the GOES system to continuously observe and measure meteorological phenomena in real time, providing the meteorological community and scientists with improved observational and measurement data of the Western Hemisphere. In addition to short-term weather forecasting and space environmental monitoring, these enhanced operational services also improve support for atmospheric science research, numerical weather prediction models, and environmental sensor design and development.

The main mission is carried out by the primary payload instruments, the Imager and the Sounder. The Imager and Sounder are Government-furnished equipment (GFE) manufactured by ITT Industries, Inc. The Imager is a multichannel instrument that senses radiant energy and reflected solar energy from the earth's surface and atmosphere and produces visible and infrared images of earth's surface, oceans, cloud cover, and severe storm developments. The Sounder provides data for vertical atmospheric temperature and moisture profiles, surface and cloud top temperature, and ozone distribution. Sounder data are also used in computer models to produce mid- and long-range weather forecasts.

A new Solar X-ray Imager (SXI), GFE manufactured by Lockheed Martin, will monitor the sun's X-rays for the early detection of coronal mass ejections and solar flares. This early warning is important because these solar flares affect not only the safety of humans in high-altitude missions, such as the Space Shuttle and International Space Station, but also military and commercial satellite communications. The GOES satellites also carry space environment monitoring instruments, built by Assurance Technology Corporation (formerly Panametrics Inc.), which monitor X-rays, extreme ultraviolet and particle emissions including solar protons, alpha particles, and electrons. These space environment monitoring instruments also include a magnetometer, built by Science Applications International Corporation (SAIC), which samples the Earth's magnetosphere. A data collection system (DCS) on GOES receives and relays environmental data sensed by widely dispersed surface platforms such as river and rain gauges, seismometers, tide gauges, buoys, ships, and automatic weather stations. Platforms transmit sensor data to the satellite at regular or self-timed intervals, upon interrogation by the satellite, or in an emergency alarm mode whenever a sensor receives information exceeding a preset level.

The GOES N-P satellites will also provide emergency communications (EMWIN). This subject is covered more fully in Section 8 of this document.

The GOES satellites transmit data collected to NOAA's Wallops, VA, ground station, which relays the data to the NOAA Satellite Operations Control Center (SOCC) in Suitland, MD. The information is then processed and distributed to users throughout the world. The search and rescue (SAR) subsystem onboard each GOES satellite is a dedicated transponder that relays the distress signals broadcast by UHF emergency locator transmitters (ELTs) carried on general aviation aircraft, emergency position indicating radio beacons (EPIRBs) aboard some classes of marine vessels, and portable personal locator beacons (PLBs). The SAR mission is performed by relaying the distress signals emitted from the ELT/EPIRBs via the GOES satellite to a Local User Terminal (LUT) ground station located within the field of view of the spacecraft.

Those desiring further information about the GOES system should contact the NOAA National Environmental Satellite, Data and Information Service (NESDIS) and/or search the following Internet addresses:

http://www.noaa.gov/

http://www.nesdis.noaa.gov/

http://www.nws.noaa.gov/

http://www.ngdc.noaa.gov/

http://www.scijinks.nasa.gov/

http://www.sec.noaa.gov/

http://rsd.gsfc.nasa.gov/goes/

http://goes2.gsfc.nasa.gov/

http://www.lmsal.com/sxi/

This page left blank.

Preface

To further enhance the utility of the GOES system, this Data Book presents a summary and technical overview of the GOES N–P system, its satellites, subsystems, sensor suite, and associated ground communication and data handling subsystems. The Data Book is intended to serve as a convenient and comprehensive desktop technical reference for people working on or associated with the GOES N–P missions as well as general information suitable for public distribution. Sufficient technical information and performance data are presented to enable the reader to understand the importance of the GOES N–P mission, the system's capabilities, and how it meets the needs of the users.

Certain performance data presented herein, e.g., Imager and Sounder radiometric performance, were predicted from or measured on previous GOES satellites. As the satellites undergo on-orbit operations and actual data are obtained, such technical information in this book may not necessarily reflect current capabilities. Furthermore, this Data Book is **not** meant to be a technical specification with absolute worst case performance numbers but rather a general document which informs the reader of nominal and typical GOES system performance and operational capabilities.

In January 1998, Hughes Space and Communications Company (HSC) of El Segundo, CA, was awarded contract number 98069 from NASA's Goddard Space Flight Center in Greenbelt, MD. The contract included the design, manufacture, integration, and launch of two Geostationary Operational Environmental Satellites, GOES N and GOES O, with options for GOES P and GOES Q. In June 2003 the GOES P option was exercised and the GOES Q option was cancelled. The GOES program is funded, managed, and operated by the National Oceanic and Atmospheric Administration (NOAA). HSC became Boeing Satellite Systems (BSS) in October 2000. Upon completion of N through P, BSS will have built a total of eight spacecraft in the GOES series.

Based on the highly successful Boeing 601 spacecraft, the new satellites will more accurately locate severe storms and other weather phenomena, resulting in more precise warnings to the public. The three-axis Boeing 601 body-stabilized spacecraft design enables the primary sensors to "stare" at earth and thus frequently image clouds, monitor earth's surface temperature, and sound earth's atmosphere for its vertical temperature and water vapor distribution. Atmospheric phenomena can be tracked, ensuring real-time coverage of short-lived dynamic events, such as severe local storms, tropical hurricanes and cyclones, meteorological events that directly affect public safety, property, and ultimately, economic health and development.

BSS will furnish the communications subsystem with a search and rescue capability to detect distress signals from ships and airplanes, and will also furnish space environmental monitoring instruments and operator training. Ground station upgrades will be provided by Boeing's teammate Integral Systems Inc. Boeing will also integrate three government-furnished instruments: the Imager and Sounder built by ITT Industries, Inc., and an SXI built by Lockheed Martin.

Acknowledgements

This Data Book had major contributions from the following lead authors at Boeing Satellite Systems: Peter Landecker and Martin Gale (Entire Book, Overview, Preface, Foreword), Simin Peng and Thomas Krause (Spacecraft Configuration), John Munro (Imager, Sounder, SXI), Ing-Yung Tse (SXI), Betty Kwan and Fred Ralph (SEM), Douglas Hein (INR), Larry Pond (Communications), Dan Carlock (T&C), Bill Krummann (Power), David Uetrecht and Jeff Kurland (ACS), Jim Finseth (Propulsion), Raymond Lee and Kenneth Dopplick (Thermal). Bob Burns and Troy Conwell (Deployment Mechanisms and Structures), Thomas Firpo and Steven Lee (SSGS), Paul Birnbaum (Spacecraft Mission Profile), Gary Johnson (On-orbit Mission Operations), and George Sevaston (IOO).

Boeing GOES program management encouragement came from Peter Graf, Charles Maloney, and Steve Archer.

The Boeing publications effort was gratefully and superbly led by Christine Stevens.

Our special thanks to Dan Arnaud who reviewed the entire Data Book. The GSFC Customer Team was led by David Mitchell and David Martin, with Paula Everson coordinating customer inputs and comments. Larry Howell of ITT provided extensive information about the Imager/Sounder. Jaya Bajpayee of GSFC provided SXI details.

This page left blank.

Databook, Uber's in-house platform for surfacing and managing contextual metadata, makes dataset discovery and exploration easier for teams across the company.Â Big data by itself, though, isnâ€™t enough to leverage insights; to be used efficiently and effectively, data at Uber scale requires context to make business decisions and derive insights.