Post Launch
Mission Operation Report
No. E-604-78-08

January 21, 1983

TO: A/Administrator

FROM: E/Associate Administrator for
Space Science and Applications

SUBJECT: Nimbus-7 (-G) Post Launch Report: Mission Success

Nimbus-7, the last of the Nimbus series satellites, was launched from the Space and Missile Test Center at Vandenberg Air Force Base, California on October 24, 1978. The purpose of the mission was to collect global data of the Earth's atmosphere, oceans and polar ice with a payload of eight interdisciplinary research experiments. These experiments represent both domestic and international, scientific and governmental communities.

Based on a review of its performance and the Prelaunch Mission Objective, I judge the Nimbus-7 Mission successful.

The objectives were, in summary, (1) to determine the feasibility to map upper atmospheric characteristics, (2) to determine the feasibility to apply space collected oceanographic data for science and application purposes, and (3) to extend the solar and earth radiation data base. These objectives have all been met or exceeded with high quality and quantity data products; the Nimbus-7 payload and spacecraft continue in good health into their fifth year of operations.

Following the development of the data processing algorithms, the data reduction, validation and archiving has proceeded on a well defined and systematic approach. Occasional problems still require the skill and dedication of the Nimbus-7 team. Although mission objectives were met earlier, mission success declaration was held in abeyance until the archival of the first year data set for all the experiments was completed.

/s/ Edelson

B. I. Edelson

Enclosures

(NASA-TM-85209) NIMBUS-7 (-G) POST LAUNCH REPORT: MISSION SUCCESS (National Aeronautics and Space Administration) 19 p
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Enclosures

1. Nimbus-7 Mission Highlights.
2. NASA Mission Objectives for Nimbus-G.
3. Assessment of the Nimbus-7 Mission.
4. Project Office Mission Success Assessment.

Nimbus-7 Mission Highlights

Objectives

All mission objectives met and exceeded.

Lifetime

Payload and spacecraft far exceeding life expectancy. They continue in good health into the fifth year of uninterrupted operation.

Data Sets

Systematically developed, validated, and archived in a form suitable for scientific applications and analysis. The data sets represent a unique, continuous set of global geophysical parameters of the earth's atmosphere, oceans, polar ice, and radiation budget plus a data set of solar radiation.

Data Application

Specific problems investigated using Nimbus real time for demonstrating use of space collected data, e.g. ozone locations and concentration for commercial airline routing; sea surface temperature and fish nutrient locations for west coast fishing ship routing and U.S. Navy; sea ice concentrations for U.S. Navy ice mapping.

Support

Continues to support many special requests for data collection and data processing for national, international, and DOD investigators.

Follow-on

Six of the eight Nimbus-7 data sets will be continued with follow-on instruments assigned to operational and research satellites.

Nimbus-7 Mission Highlights (Continued)

Scientific Accomplishments

(Results of data validation only. The Nimbus Program processes, validates and archives; it is not responsible for data analysis).

- o CZCS - Pigment concentration and diffuse attention coefficient determined to ±35% (Goal: a factor of 2).

- o ERB - Detected short-term variations in solar irradiance ("constant") of the order 0.1 to 0.2% (1.0 to 3.0 w/m^2) related to solar activity.
  - Recognized short-term variability in near UV similar in nature to that observed with solar constant.
  - Discovered apparent downward trend in solar constant (.02-.04%/yr).
  - Developed data base for studying angular reflectance and emittance characteristics of earth and cloud surfaces.

- o LIMS - First global measurements of HNO_3 and NO_2 (PPB range)
  - First global measurements of stratospheric H_2O vapor distribution.
  - Detailed observation of very active stratospheric warming.

- o SAM II - Observations of seasonal and spatial variations of stratospheric aerosols.
  - Discovery and quantification of polar stratospheric clouds.

- o SBUV/ TOMS - First high quality, high resolution global data ozone data set (TOMS).
  - Provides "space truth" for ground observing network.

- o SMMR - First global ocean and polar ice climatological data base of sea surface temperature, sea ice concentration, multi-year sea ice fractions, and atmospheric water vapor.

- o THIR - Cloud information provides basis for improvements in earth radiation budget and ozone parameters derived from satellites.

- o SAMS - Mesospheric and thermospheric emission by resonance fluorescence observed in H_2O, CO, NO, and CO_2.

NASA MISSION OBJECTIVES FOR NIMBUS-G

PRIMARY OBJECTIVES

Acquisition of data from two of the four instruments: the Limb Infrared Monitoring of the Stratosphere (LIMS); the Solar Backscattered Ultraviolet and Total Ozone Mapping System (SBUV/TOMS); the Stratospheric and Mesospheric Sounder (SAMS); or the Stratospheric Aerosol Measurement II (SAM II), for determining the feasibility to map sources, sinks, and dispersion mechanisms of stratospheric/mesospheric gaseous and particulate pollutants, for a period of 3 months.

Acquisition of data from either the Coastal Zone Color Scanner (CZCS) or the Scanning Multichannel Microwave Radiometer (SMMR), for a period of 3 months, to determine the feasibility of applying remotely-sensed oceanographic data to applications such as:

- Detection of upper level ocean pollutants
- Determination of the nature of water-suspended materials
- Mapping of: sediments, biologically productive areas, interactions between coastal effluents and open ocean waters
- Sea surface temperature mapping
- Sea ice characteristics and location
- Ship route forecast improvement

SECONDARY OBJECTIVES

Make quantitative measurements of air surface/boundary conditions or of precipitation in support of the Global Atmospheric Research Program (GARP) for a period of 3 months using SMMR data,

OR

Continue to extend the base of measurements of variations of short and long wave radiation fluxes outside the atmosphere by acquisition of data from the Earth Radiation Budget (ERB) experiment for a period of 3 months, or continue to extend the base of measurements of atmospheric constituents by acquisition of data from the SBUV/TOMS or the LIMS for a period of 3 months.

L. R. Greenwood, Director
Environmental Observations Division
Office of Space & Terrestrial Applications

Date: 8/30/78

Anthony J. Calio
Associate Administrator for Space and
Terrestrial Applications

Date: 8/30/78

Assessment of the Nimbus-7 Mission

Based on a review of its performance and Prelaunch Mission Objective, Nimbus-7, launched October 24, 1978, is judged successful.

S. G. Tilford
Director
Environmental Observation Division

Date: 1/21/83

B. I. Edelson
Associate Administrator for Space Science and Applications

Date: 1/21/83

NIMBUS-7 MISSION SUCCESS STATEMENT

NIMBUS-7 MISSION SUCCESS STATEMENT

ALL MISSION OBJECTIVES MET AND EXCEEDED

SPACECRAFT AND INSTRUMENTS CONTINUE UNINTERRUPTED OPERATION INTO 5TH YEAR.

- **LIMS CRYOGEN DEPLETED AFTER 7 MONTHS**
- **ERB NARROW FIELD SCANNER FAILED AFTER 19 MONTHS**
- **SAMS SCAN MECHANISM DEVELOPED IRREGULARITIES AFTER 48 MONTHS**

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NIMBUS-G MISSION OBJECTIVES

PRIMARY

- 3 MONTHS OF DATA FROM TWO OF FOUR INSTRUMENTS TO DETERMINE FEASIBILITY TO MAP — LIMS, SBUV/TOMS, SAMS OR SAM II
- 3 MONTHS OF DATA FROM EITHER ONE OF TWO INSTRUMENTS TO DETERMINE FEASIBILITY TO APPLY — CZCS OR SMMR

SECONDARY

- 3 MONTHS QUANTITATIVE MEASUREMENTS OF SMMR DATA TO SUPPORT GARP – AIR SURFACE/BOUNDARY CONDITIONS OR PRECIPITATION

OR

- 3 MONTHS OF MEASUREMENTS TO EXTEND DATA BASE FROM – ERB OR SBUV/TOMS OR LIMS

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NIMBUS-7 MISSION SUCCESS STATEMENT

COASTAL ZONE COLOR SCANNER (CZCS)

OPERATIONS

- INSTRUMENT OPERATION SATISFACTORY

DATA PROCESSING AND ARCHIVAL

- APPROXIMATELY 21,000 SCENES ARCHIVED
- APPROXIMATELY 350 LEVEL II PRODUCTS ARCHIVED

ACCOMPLISHMENTS

- PIGMENT CONCENTRATION AND DIFFUSE ATTENUATION COEFFICIENT DETERMINED TO ± 35% (GOAL A FACTOR OF 2)
- AEROSOL BACKSCATTER AND RAYLEIGH PATH RADIANCE CONTAMINATION REMOVED
- QUASI-OPERATIONAL TUNA FLEET DEMONSTRATION

NIMBUS-7 MISSION SUCCESS STATEMENT

EARTH RADIATION BUDGET EXPERIMENT (ERB)

OPERATIONS

- SOLAR AND WIDE FIELD OF VIEW SENSORS SATISFACTORY
- NFOV SCANNER OPERATED FOR 19 MONTHS

DATA PROCESSING AND ARCHIVAL

- TWO YEARS OF IRRADIANCE DATA ARCHIVED
- ONE YEAR OF EARTH RADIATION BUDGET AND SOLAR PRODUCTS ARCHIVED

SCIENTIFIC ACCOMPLISHMENTS

- DETECTED SHORT TERM VARIATIONS IN SOLAR IRRADIANCE ('CONSTANT') OF THE ORDER 0.1 TO 0.2% (1.0 - 3.0 W/M^2) RELATED TO SOLAR ACTIVITY
- RECOGNIZED SHORT-TERM VARIABILITY IN NEAR UV SIMILAR IN NATURE TO THAT OBSERVED WITH SOLAR CONSTANT
- DISCOVERED APPARENT DOWNWARD TREND IN SOLAR CONSTANT (.02 - .04%/YEAR)
- DEMONSTRATED THAT CALIBRATION OF CAVITY RADIOMETERS COULD BE MAINTAINED IN ORBIT TO 0.05%
- DEVELOPED DATA BASE FOR STUDYING ANGULAR REFLECTANCE AND EMITTANCE CHARACTERISTICS OF EARTH AND CLOUD SURFACES
- DEVELOPED EMPIRICAL ANGULAR DISTRIBUTION RADIANCE MODELS FOR CLOUDS, SNOW/ICE, AND SEVERAL LAND TYPES

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NIMBUS-7 MISSION SUCCESS STATEMENT

LIMB INFRARED MONITOR OF THE STRATOSPHERE (LIMS)

OPERATIONS

- INSTRUMENT OPERATED FOR 7 MONTHS (MISSION OBJECTIVE 3 MONTHS)

DATA PROCESSING AND ARCHIVAL

- DATA SET FOR ENTIRE PERIOD ARCHIVED

SCIENTIFIC ACCOMPLISHMENTS

- FIRST GLOBAL MEASUREMENTS OF HNO_3 AND NO_2 (PPB RANGE). MEASUREMENTS SHOW LATITUDINAL GRADIENTS AND SEASONAL CHANGES IN CONCENTRATION
- FIRST GLOBAL MEASUREMENTS OF STRATOSPHERIC WATER VAPOR DISTRIBUTION
- DETAILED OBSERVATION OF VERY ACTIVE STRATOSPHERIC WARMING
- OBSERVATION OF $T - O_3$ ANTI–CORRELATION AT UPPER LEVELS
- MEASUREMENT OF TROPOPAUSE HEIGHT

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NIMBUS-7 MISSION SUCCESS STATEMENT

STRATOSPHERIC AEROSOL MEASUREMENT EXPERIMENT (SAM II)

OPERATIONS

- SUNRISE & SUNSET DATA TAKEN EVERY ORBIT

DATA PROCESSING AND ARCHIVAL

- 3 YEARS OF DATA VALIDATED TO THE ARCHIVE
- 4TH YEAR SCHEDULED FOR ARCHIVAL IN SEPTEMBER 1983

SCIENTIFIC ACCOMPLISHMENTS

- OBSERVATIONS OF SEASONAL AND SPATIAL VARIATIONS OF STRATOSPHERIC AEROSOLS
- DISCOVERY AND QUANTIFICATION OF POLAR STRATOSPHERIC CLOUDS
- DEVELOPMENT OF POLAR CIRRUS CLOUD CLIMATOLOGY
- EFFECTS OF SUDDEN WARMINGS ON THE STRATOSPHERIC AEROSOL LAYER ARE BEING QUANTIFIED

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NIMBUS-7 MISSION SUCCESS STATEMENT

STRATOSPHERIC AND MESOSPHERIC SOUNDER (SAMS)

OPERATIONS

INSTRUMENTS OPERATED SUCCESSFULLY FOR 48 MONTHS

- NITRIC OXIDE CHANNEL FAILED AFTER 18 MONTHS
- MIRROR SCAN MECHANISM DEVELOPED IRREGULARITIES AFTER 48 MONTHS

DATA PROCESSING AND ARCHIVAL

- FIRST YEAR DATA DECLARED VALID FOR ARCHIVAL
- DATA PAST FIRST YEAR NOW BEING PROCESSED AT FOUR TIMES REAL TIME

SCIENTIFIC ACCOMPLISHMENTS

- GLOBAL TEMPERATURE DATA FORMS A CONTINUOUS RECORD EXTENDING BACK TO 1970 (NIMBUS 4)
- FOUR YEAR CONTINUOUS RECORD OF DISTRIBUTION AND VARIABILITY OF N_2O, CH_4, H_2O AND CO (PLUS 18 MONTHS OF NO)
- STUDIES OF PHENOMENA (SUDDEN WARMINGS, WAVE MOTIONS, MIDDLE ATMOSPHERE CHEMISTRY, ETC.)
- MESOSPHERIC AND THERMOSPHERIC EMISSION BY RESONANCE FLUORESCENCE OBSERVED IN H_2O, CO, NO AND CO_2

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NIMBUS-7 MISSION SUCCESS STATEMENT

SOLAR BACKSCATTER ULTRAVIOLET AND TOTAL OZONE MAPPING SPECTROMETER EXPERIMENT (SBUV/TOMS)

OPERATIONS

- INSTRUMENT OPERATION SATISFACTORY

DATA PROCESSING AND ARCHIVAL

- TWO YEARS OF DATA ARCHIVED
- DATA PROCESSING UNDERWAY
- EFFECT OF EL CHICHON UNDER STUDY

SCIENTIFIC ACCOMPLISHMENTS

- FIRST HIGH QUALITY, HIGH RESOLUTION GLOBAL TOTAL OZONE DATA SET (TOMS).
- PROVIDES "SPACE TRUTH" FOR GROUND OBSERVING NETWORK
- REAL TIME TOMS AIRCRAFT OZONE AVOIDANCE EXPERIMENT
- MAPPING OF STRATOSPHERIC OZONE CONTOURS
- OBSERVATION OF SHORT TERM UV FLUCTUATIONS IN SOLAR FLUX

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NIMBUS-7 MISSION SUCCESS STATEMENT

SCANNING MULTICHANNEL MICROWAVE RADIOMETER (SMMR)

OPERATIONS

- INSTRUMENT OPERATION SATISFACTORY

DATA PROCESSING AND ARCHIVAL

- FIRST YEAR DATA ARCHIVED
- PROCESSING YEAR 2 AND YEAR 4 BEGUN

SCIENTIFIC ACCOMPLISHMENTS

- CLIMATOLOGICAL DATA BASE OF SEA SURFACE TEMPERATURE, SEA ICE CONCENTRATION, MULTIYEAR SEA ICE FRACTIONS, ATMOSPHERIC WATER VAPOR, AND SEA SURFACE WIND

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NIMBUS-7 MISSION SUCCESS STATEMENT

TEMPERATURE HUMIDITY INFRARED RADIOMETER (THIR)

OPERATIONS

- INSTRUMENT OPERATION SATISFACTORY

SCIENCE TEAM

- THIR DATA UTILITY LEAD TO FORMATION OF AN AD HOC SCIENCE TEAM
- PRODUCTION OF A LONG TERM GLOBAL CLOUD CLIMATOLOGY FROM THIR AND SBUV/TOMS DATA APPROVED

DATA PROCESSING AND ARCHIVAL

- 3 YEARS CALIBRATED AND LOCATED DATA TAPE (CLDT), CLOUD FOR ERB (CLE), AND CLOUD FOR TOMS (CLT) ARCHIVED
- PROCESSING OF DATA FOR YEAR 4 IS 50% COMPLETE

SCIENTIFIC ACCOMPLISHMENTS

- CLOUD INFORMATION GENERATED FROM THIR DATA USED TO IMPROVE THE ACCURACY OF OZONE RETRIEVALS
- CLOUD INFORMATION FOR ERB'S SUB-TARGET AREA USED IN EARTH RADIATION BUDGET STUDY

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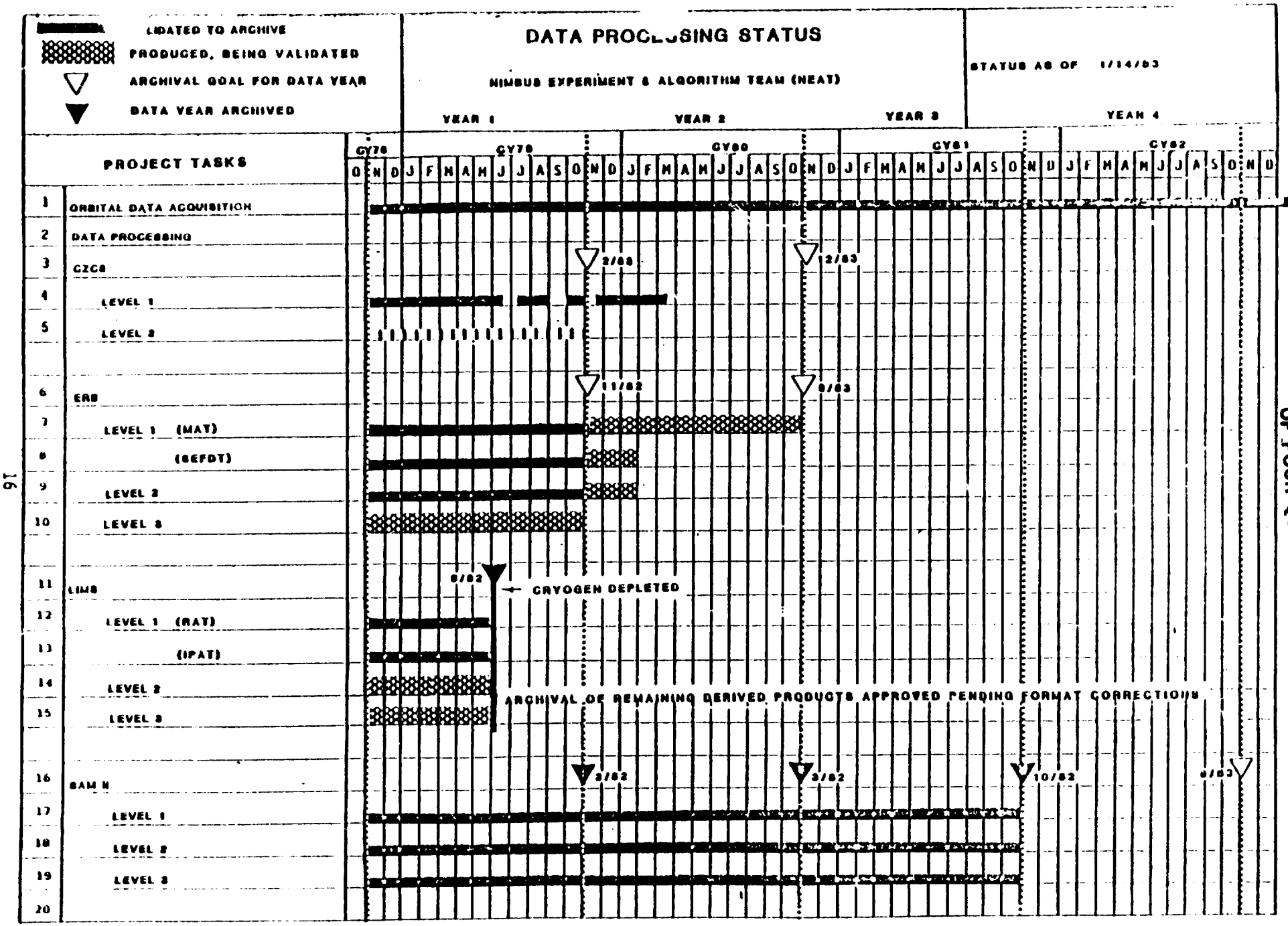

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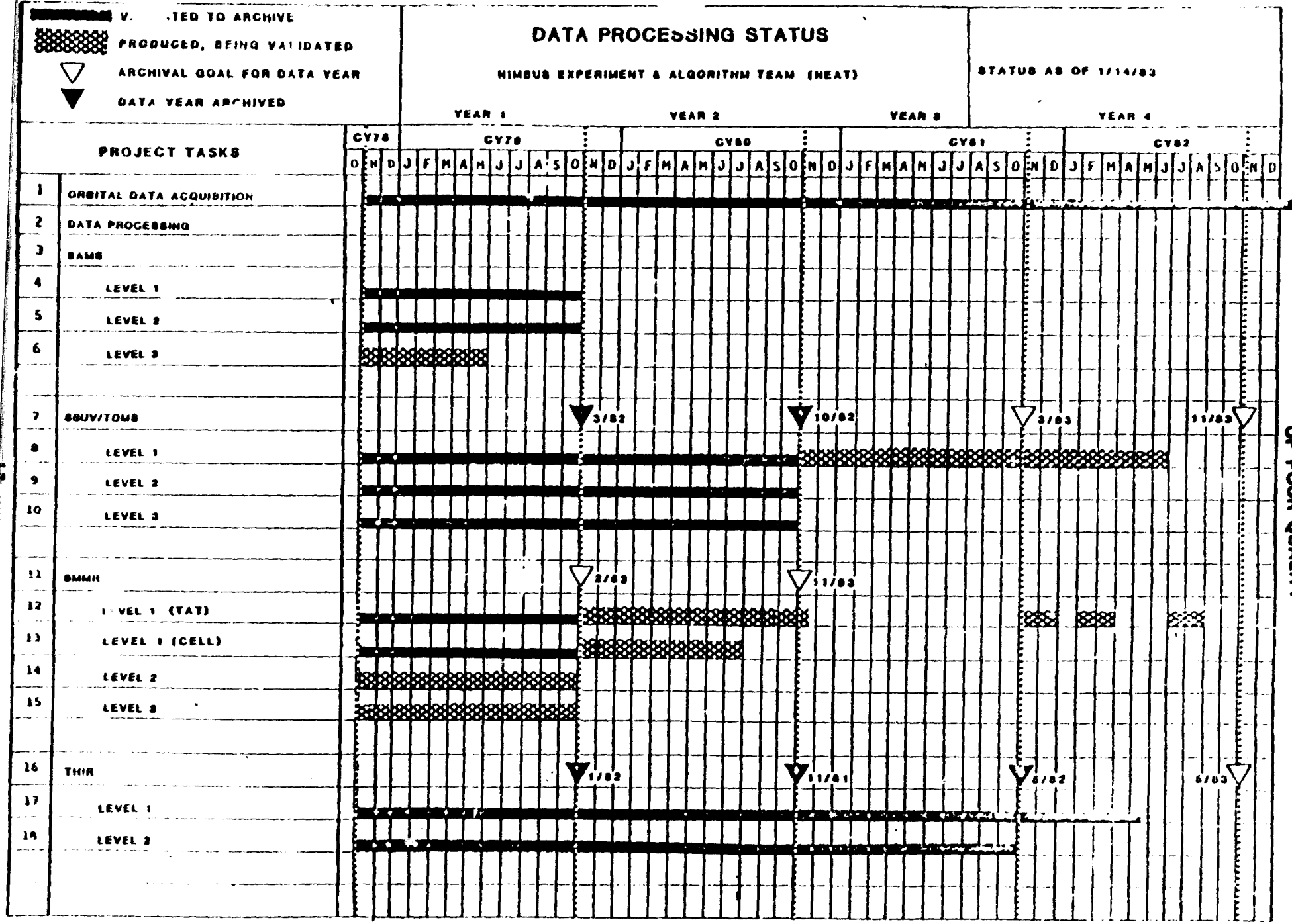

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