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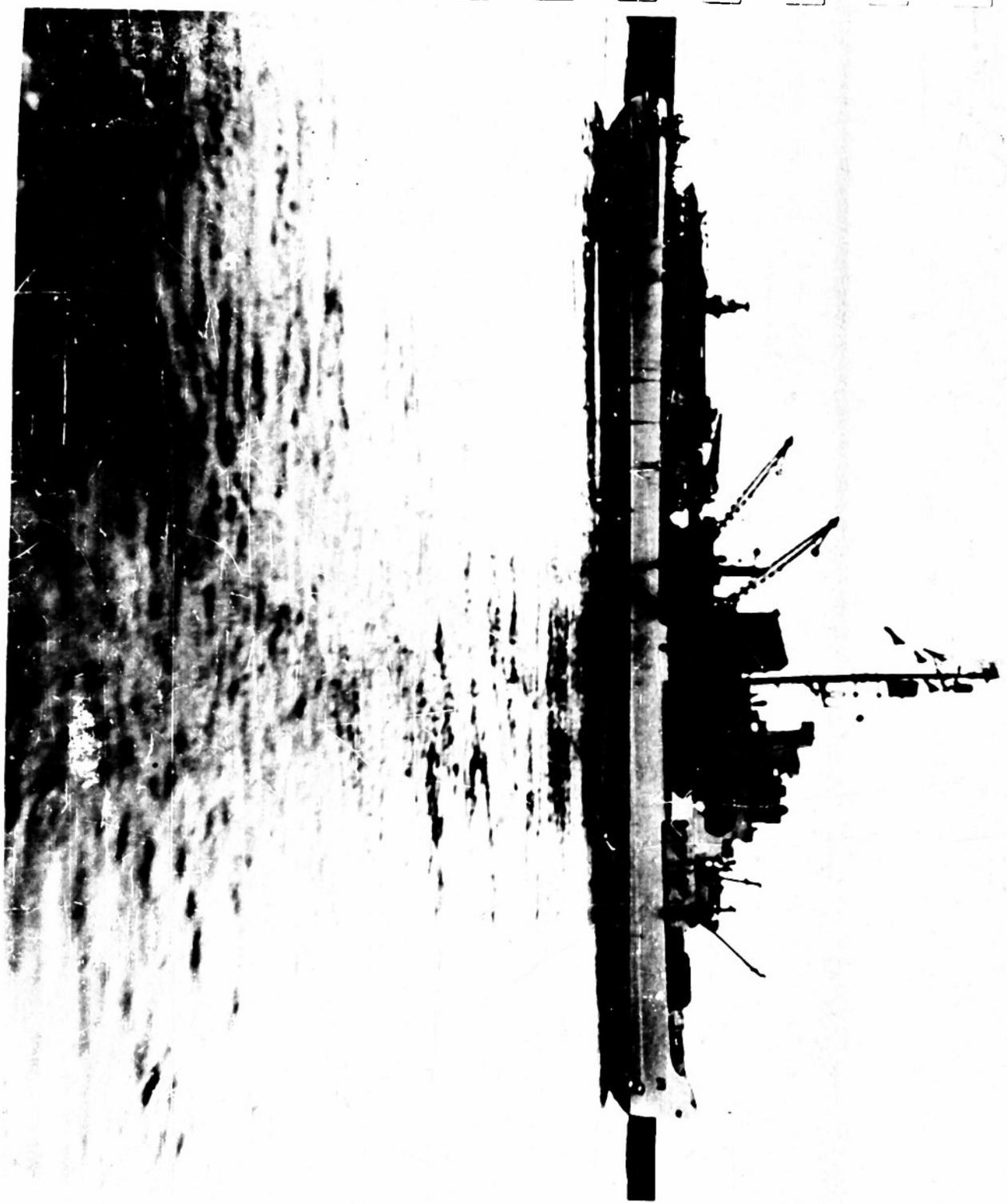


GENERAL MILLS, INC.
Engineering Research & Development Department
2003 E. Hennepin Ave.
Minneapolis 13, Minn.

FINAL REPORT

PROJECT 85006

PREPARED FOR

THE OFFICE OF NAVAL RESEARCH

WASHINGTON, D. C.

REPORT NO.: 1239

DATE: 2 OCTOBER 1953

PROJECT: 85006

PREPARED BY: Keith C. Giles
Keith C. Giles

APPROVED BY: J. R. Smith
J. R. Smith
Balloon and Meteorological
Systems Group

FINAL REPORT PROJECT 85006

I. INTRODUCTION

On 29 May 1952, Contract Nonr-875(00) between the Office of Naval Research and General Mills, Inc. was amended to provide for an experiment to carry scientific equipment to high altitudes by means of "Skyhook" type plastic balloons. The scientific payloads were supplied by:

1. The University of Iowa, whose payload was a Deacon rocket with nose cones outfitted to make cosmic ray measurements.
2. New York University, whose principle payload was a neutron counter.
3. The University of Chicago, whose principle payload was a photographic device.

General Mills, Inc. supplied balloons, telemetering, and termination gear, together with technical personnel to supervise inflation and launching of the balloons.

All flights were launched from the flight deck of the U. S. Coast Guard Cutter "Eastwind" in the North Baffin Bay and Kane Basin regions between Greenland and Northeastern Canada.

General Mills, Inc. was not responsible for tracking and recovery so those problems are not treated in detail in this report. Meteorological observations were supplied by the Coast Guard Cutter aerographic facilities. Where applicable, tracking and recovery were carried out by planes assigned from Navy facilities at Thule Air Force Base. Helium used in inflation was supplied by the Navy, in standard small cylinders, manifolded together.

II. PROJECT PROGRAM

A. University of Iowa Flights

This program consisted of 7 flights. No accessory balloon controls were sent up with the balloons, only the payload, a rocket. The firing mechanism was contained within each rocket.

The first flight used a 55 foot General Mills balloon. After a successful launch, the balloon entered a cloud deck. Through breaks in the clouds the balloon was observed to be fully inflated, indicating pressure altitude had been reached, but the rocket failed to fire.

The second flight used a 55 foot General Mills balloon. This flight was launched successfully but, again, the rocket failed to fire after reaching altitude. The firing circuit was found to be faulty and was replaced with balloon control equipment especially designed to operate at combined low temperatures and low pressures.

The third, fourth, fifth, and sixth flights used 55 foot GMI balloons and were successful in both launching and rocket firing.

The seventh, and last, rocket flight used a 73 foot Winzen balloon to achieve greater altitude and was successful in launching and rocket firing.

Since these balloons carried no accessory balloon equipment, no balloon data are available for analysis.

B. New York University Flights

This portion of the program consisted of 5 flights. Each flight carried the following items:

1. A radio transmitter whose frequency was pressure modulated for pressure-altitude telemetering.

2. A time control set to release the equipment from the balloon at a predetermined time.

3. A scientific payload furnished by the New York University.

4. A parachute on which the equipment returned to earth after release from the balloon.

5. A 20 foot tow balloon used to lift the radio transmitter and antenna during the initial portion of the flight.

The first flight attempted used a 73 foot Winzen balloon as the vehicle. During inflation, a large tear was discovered; as the tear was across an entire gore, the balloon was cut loose.

The second flight, #954, used a 73 foot Winzen balloon. Launching was attempted in a snowstorm, wet snow accumulating on the balloon, and additional gas was introduced to permit a normal ascent. This flight rose to 45,000 feet, then descended slowly, apparently as a result of leaks.

The third flight also used a 73 foot Winzen balloon. Launching was accomplished successfully but the balloon returned to earth in 20 minutes. The flight train was recovered and a large hole was found in the balloon.

The fourth flight, #958, used an 85 foot GMI Balloon. The flight was launched and performed successfully.

The fifth flight, #964, used an 85 foot GMI balloon and, in addition to carrying the New York University gondola, also carried the University of Chicago gondola. The balloon was launched and reached altitude, 90,000 feet, but instead of floating as desired, slowly started to descend. Recovery was attempted on this flight, but even though the equipment was spotted down on the ground, it was not possible for the Navy recovery team to effect a pick-up.

Performance data on these flights are presented at the end of this report.

C. University of Chicago Flights

These flights, like those of the New York University, carried a pressure modulated radio transmitter, scientific payload, timer control, a tow balloon to lift the beacon and antenna during the initial flight period, and a parachute, in this case red, since recovery was desired. Three flights constituted this portion of the program.

The first flight, #960, used an 85 foot GMI balloon. This flight was launched and performed successfully, but recovery attempts again proved unsuccessful.

The second flight, #962, used a 116 foot GMI balloon. The balloon ruptured at 47,000 feet.

The third flight, #965, used a 116 foot GMI balloon. This balloon was inflated and launched successfully, suffering no apparent damage during the layout and handling period. After a few minutes, however, the balloon failed and returned to earth. The balloon was brought along-side the ship and examined. No holes or damage were found.

Performance data are presented at the end of this report.

III. SUMMARY

A total of 15 flights were flown under this program; 4 with Winzen balloons provided by ONR and 11 with GMI balloons. Seven rocket launchings were carried out with complete balloon success, although the first 2 rockets failed to fire due to a faulty firing circuit. The complete success of the remaining 5 rocket-balloon combinations marks a significant step forward in the exploration of the upper air.

Eight other high-altitude flights were undertaken. On the first three of these, poor balloon performance was experienced and it was necessary to re-fly the New York University equipment involved. On the fourth, fifth, and sixth flights, the New York University requirements were completely satisfied, and two successful exposures of the Chicago gear were achieved. The last two flights were made in a vain effort to get a third successful flight for the University of Chicago.

Table I gives the summary of flights, and Table II shows the success record of various balloons flown. From this table it would appear that certain balloon designs fared better than others. This is not borne out, however, by the previous records of these balloons, and no real conclusions can be drawn from these few statistics.

TABLE I

Flight No.	Date	Type	Results
951	8-21-52	N.Y.U.	Poor - torn balloon cut loose
952	8-21-52	Iowa-Rocket	Rocket failed to fire - balloon good
953	8-23-52	Iowa-Rocket	Rocket failed to fire - balloon good
954	8-27-52	N.Y.U.	Poor - balloon leak
955	8-28-52	N.Y.U.	Poor - hole in balloon
956	8-28-52	Iowa-Rocket	Good
957	8-29-52	Iowa-Rocket	Good
958	8-29-52	N.Y.U.	Good
959	8-29-52	Iowa-Rocket	Good
960	8-31-52	U. of Chicago	Good
961	8-31-52	Iowa-Rocket	Good
962	9-1-52	U. of Chicago	Poor - balloon ruptured on ascent
963	9-4-52	Iowa-Rocket	Good
964	9-4-52	N.Y.U. and U. of Chicago	Good
965	9-4-52	U. of Chicago	Poor - balloon leak

TABLE II

BALLOON SUCCESS

Type	No. Flown	No. Successful
BMI 55'	6	6
Winzen 73'	4	1
GMI 85'	3	3
GMI 1161'	2	0

General Mills, Inc. is happy to have had the opportunity of working with the Office of Naval Research and the University of Iowa, the University of Chicago, and New York University in conducting this high altitude experiment. It is hoped that the scientific results met with complete success.

GENERAL MILLS, INC.
Engineering Research & Development Dept.
Minneapolis, Minn.

FLIGHT SUMMARY

Flight No.: 954 — Balloon Serial No.: Unknown

Date: 27 Aug. 1952 Launching Time: 1052 — Type: 733 Winsen Weight: 122# Estd.

Who: New York University

What: 105 MCPA Beacon, Gondola, Instrument Bag

Duration: Actual 4.7 hrs. to impact — Load on Balloon: 153#

Gross Load: 275# — Free Lift: 5# 2%

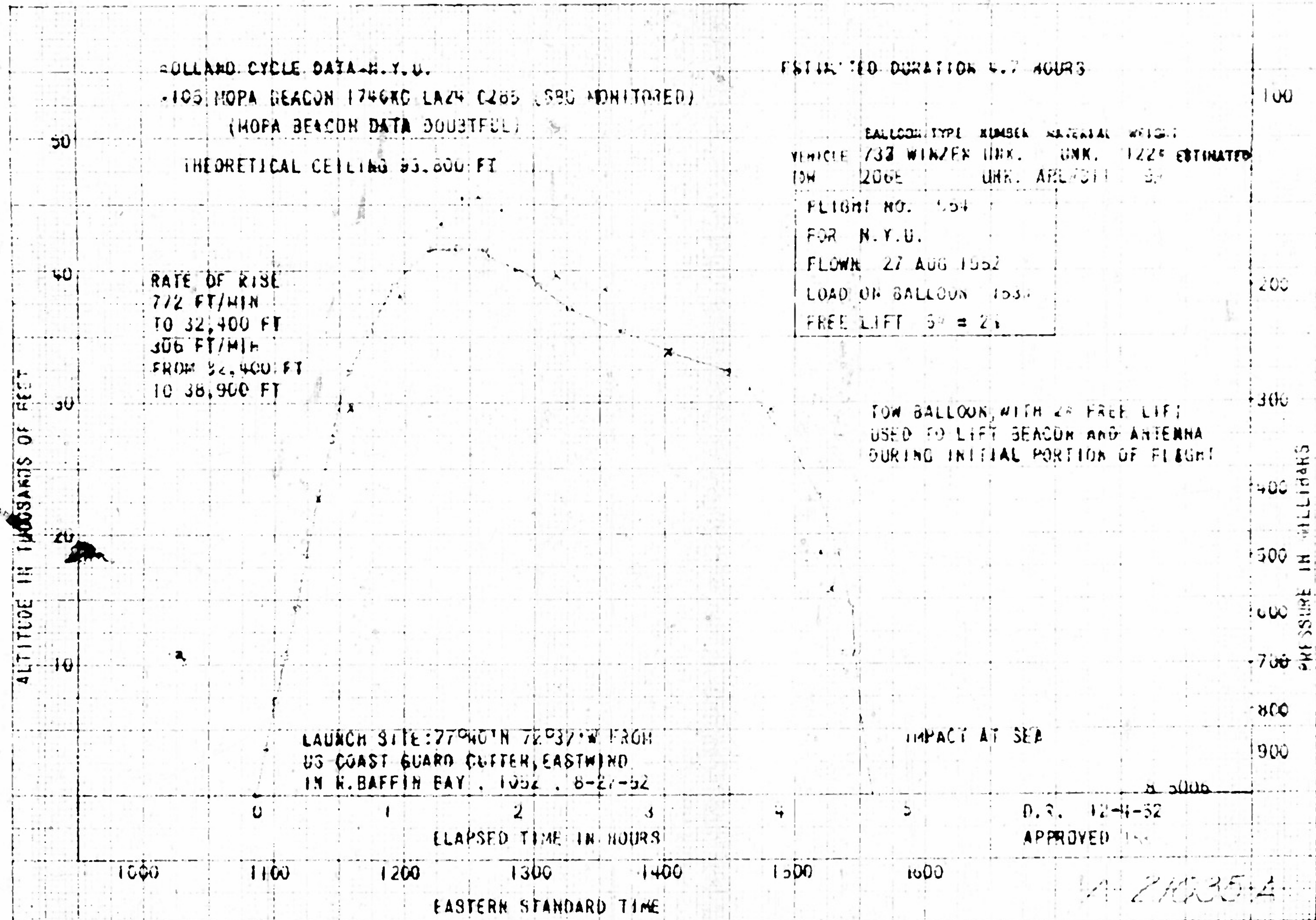
Maximum Altitude: 41,600 ft. — Rate of rise: 772 ft/min. to 32,400 ft.
306 ft/min. to 38,900 ft.

Theoretical Altitude: 93,800 ft. — Altitude Maintenance: Poor

Recovery: where? None - impact at sea

Balloon success: Poor

Critique: Launching attempted in a snowstorm. Wet snow accumulating on balloon. Balloon rose only to 45,000 ft. before descending.



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OCT 1 1953

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Engineering Research & Development Dept.
Minneapolis, Minn.

FLIGHT SUMMARY

Flight No.: 958 — Balloon Serial No.: 495

Date: 8-29-52 Launching Time: 0641 EST — Type: 851A Weight: 156#

Who: New York University

What: N.Y.U. Gondola

Duration: Scheduled 4.3 hrs. — Load on Balloon: 158#

Actual 4.2 hrs.

Gross Load: 314# — Free Lift: 11# 4%

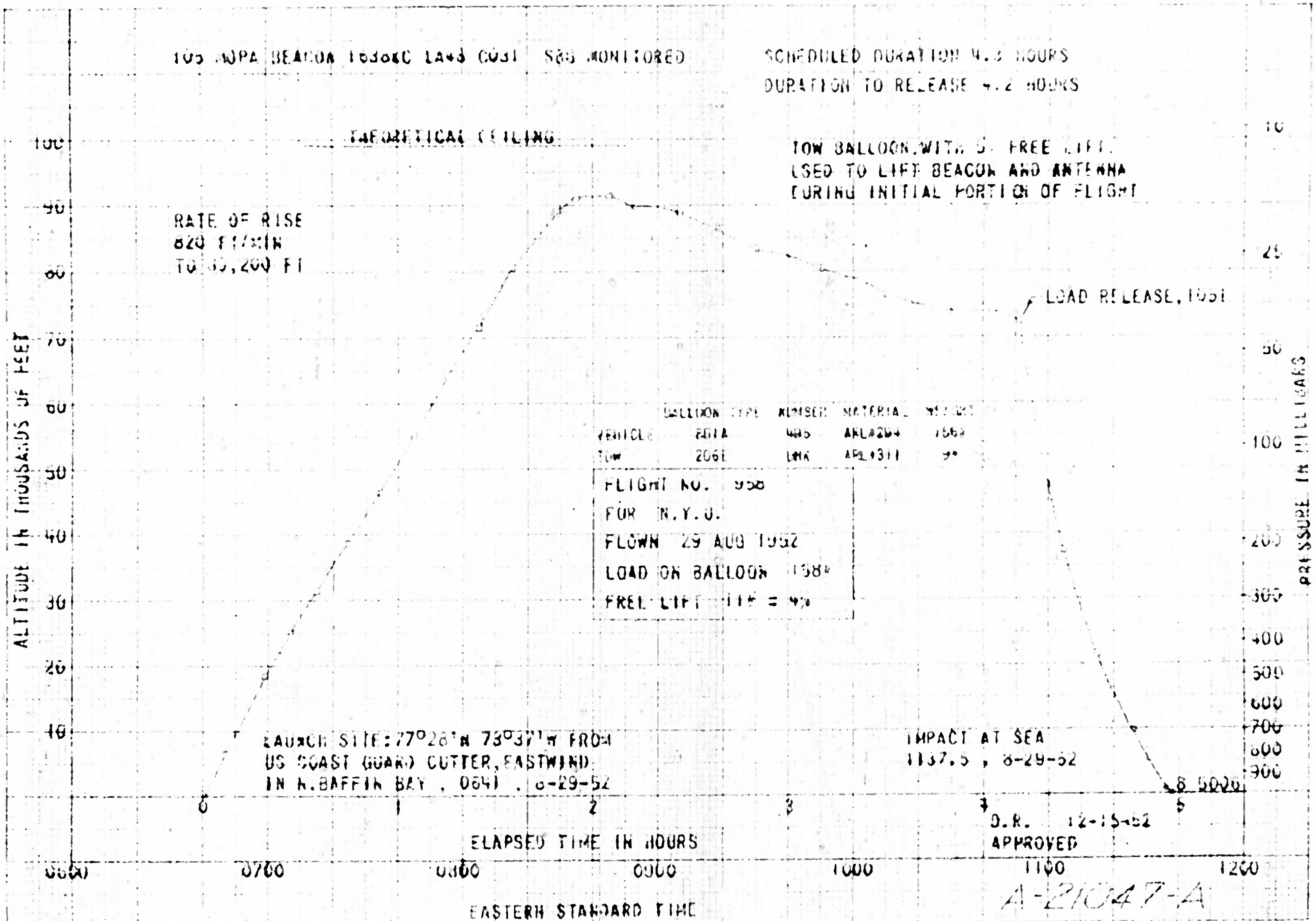
Maximum Altitude: 91,500 — Rate of Rise: 820 ft/min. to 89,200 ft.

Theoretical Altitude: 99,000

Recovery: where? None - impact at sea

Balloon Success: Excellent

Critique: Balloon launched and performed successfully.



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OCT 1 1953

GENERAL MILLS, INC.
Engineering Research & Development Dept.
Minneapolis, Minn.

FLIGHT SUMMARY

Flight No.: 960 Balloon Serial No.: 294

Date: 31 Aug. 1952 Launching Time: 0702 EST Type: 851A Weight: 154#

Who: U. of Chicago

What: 105 MOPA Beacon, Gondola, Instrument Bag, Ballast Cans

Duration: Scheduled 8 hrs. Load on Balloon: 206#

Actual 7.9 hrs. to release

Gross Load: 360# Free Lift:

Maximum Altitude: 90,000 ft. Rate of Rise 573 ft/min. to 59,000 ft.

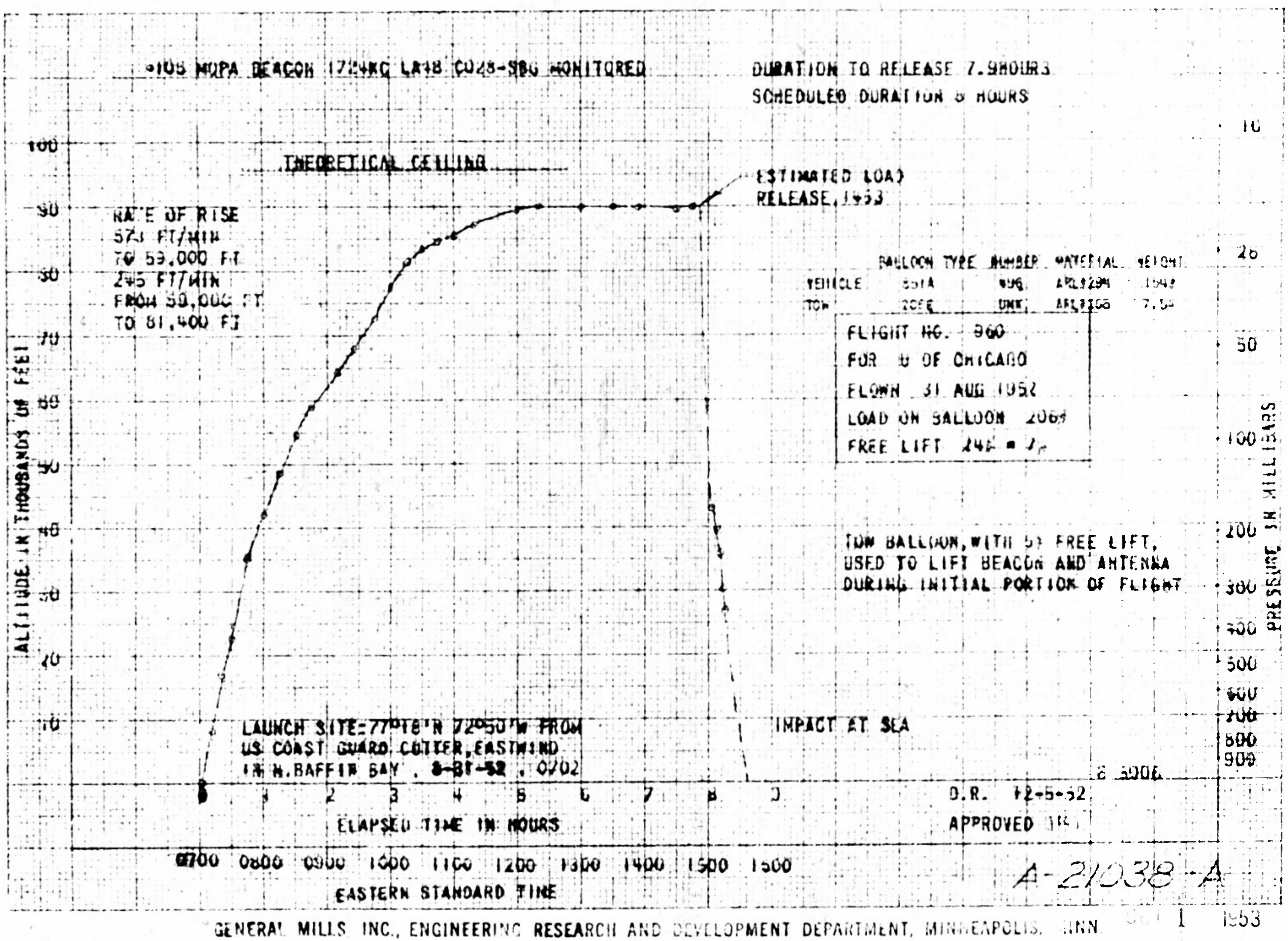
245 ft/min. to 81,400 ft.

Theoretical Altitude: 95,700 ft. Altitude Maintenance: Excellent

Recovery: where? None - impact at sea

Balloon success: Excellent

Critique: Flight launched and performed as desired.



#105 MOPA BEACON 1724KC LA48 CO28-980 MONITORED
DURATION TO RELEASE 7.9HOURS
SCHEDULED DURATION 6 HOURS
THEORETICAL CEILING
ESTIMATED LOAD RELEASE, 1453
RATE OF RISE
573 FT/MIN
TO 59,000 FT
245 FT/MIN
FROM 59,000 FT
TO 81,400 FT
BALLOON TYPE NUMBER MATERIAL WEIGHT
VEHICLE
TOW
FLIGHT NO. 960
FOR U OF CHICAGO
FLOWN 31 AUG 1952
LOAD ON BALLOON
FREE LIFT
TOW BALLOON, WITH FREE LIFT, USED TO LIFT BEACON AND ANTENNA DURING INITIAL PORTION OF FLIGHT
LAUNCH SITE=77°18'N 72°50'W FROM US COAST GUARD CUTTER, EASTWIND IN N. BAFFIN BAY, 8-31-52, 0702
IMPACT AT SEA
ALTITUDE IN THOUSANDS OF FEET
PRESSURE IN MILLIBARS
ELAPSED TIME IN HOURS
EASTERN STANDARD TIME
0700 0800 0900 1000 1100 1200 1300 1400 1500 1600
D.R. 12-5-52
APPROVED
A-21038-A
GENERAL MILLS INC., ENGINEERING RESEARCH AND DEVELOPMENT DEPARTMENT, MINNEAPOLIS, MINN.

GENERAL MILLS, INC.
Engineering Research & Development Dept.
Minneapolis, Minn.

FLIGHT SUMMARY

Flight No.: 962 Balloon Serial No.: 20

Date: 1 Sept. 1952 Launching Time: 1213 EST Type: 1161A Weight: 276#

Who: University of Chicago

What: 120 MOPA Beacon, Gondola, Instrument Bag, Ballast Cans, Barograph

Duration: Scheduled: 9 hr. from 1115 Load on Balloon: 94#

Actual: 1 hr. to impact

Gross Load: 370# Free Lift: 30# 8%

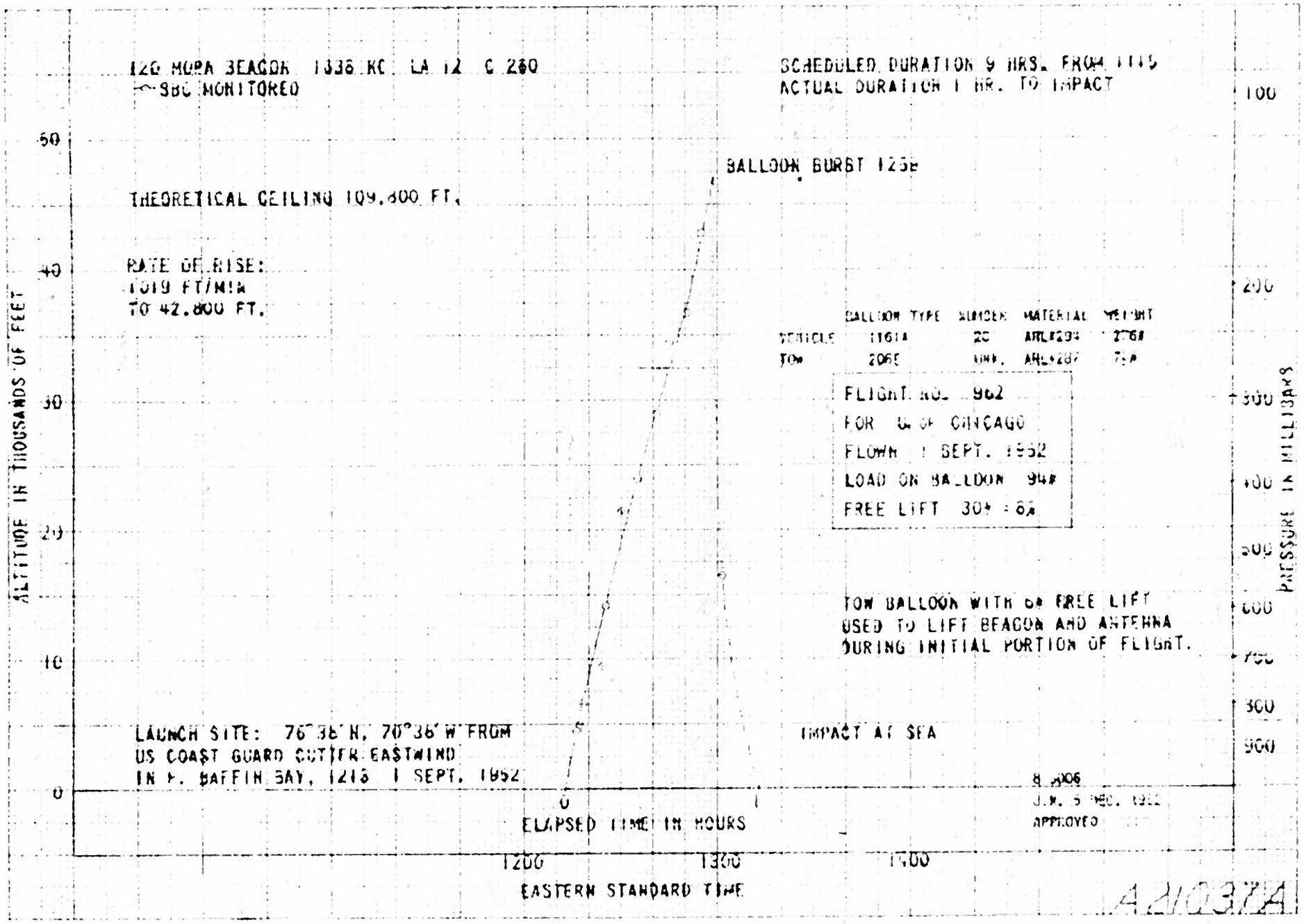
Maximum Altitude: 47,200 ft. Rate of rise: 1019 ft/min. to 42,800 ft.

Theoretical Altitude: 109,800 ft. Altitude Maintenance: None

Recovery: where? None - impact at sea

Balloon Success: Very poor

Critique: Rate of rise too great causing rupture about 47,000 ft. This caused by tow balloon.



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OCT 1 1953

GENERAL MILLS, INC.
Engineering Research & Development Dept.
Minneapolis, Minn.

FLIGHT SUMMARY

Flight No.: 964 Balloon Serial No.: 493

Date: 4 Sept. 1952 Launching Time: 1122EST Type 851A Weight: 152#

Who: N.Y.U. and U. of Chicago

What: 120 MOPE Beacon N.Y.U. Gondola, U/Chicago Gondola, Instrument Bag

Duration: Scheduled 5 3/4 hrs. Load on Balloon: 250#

Actual 5 1/2 hrs. to impact

Gross Load: 402# Free Lift: 14# 3%

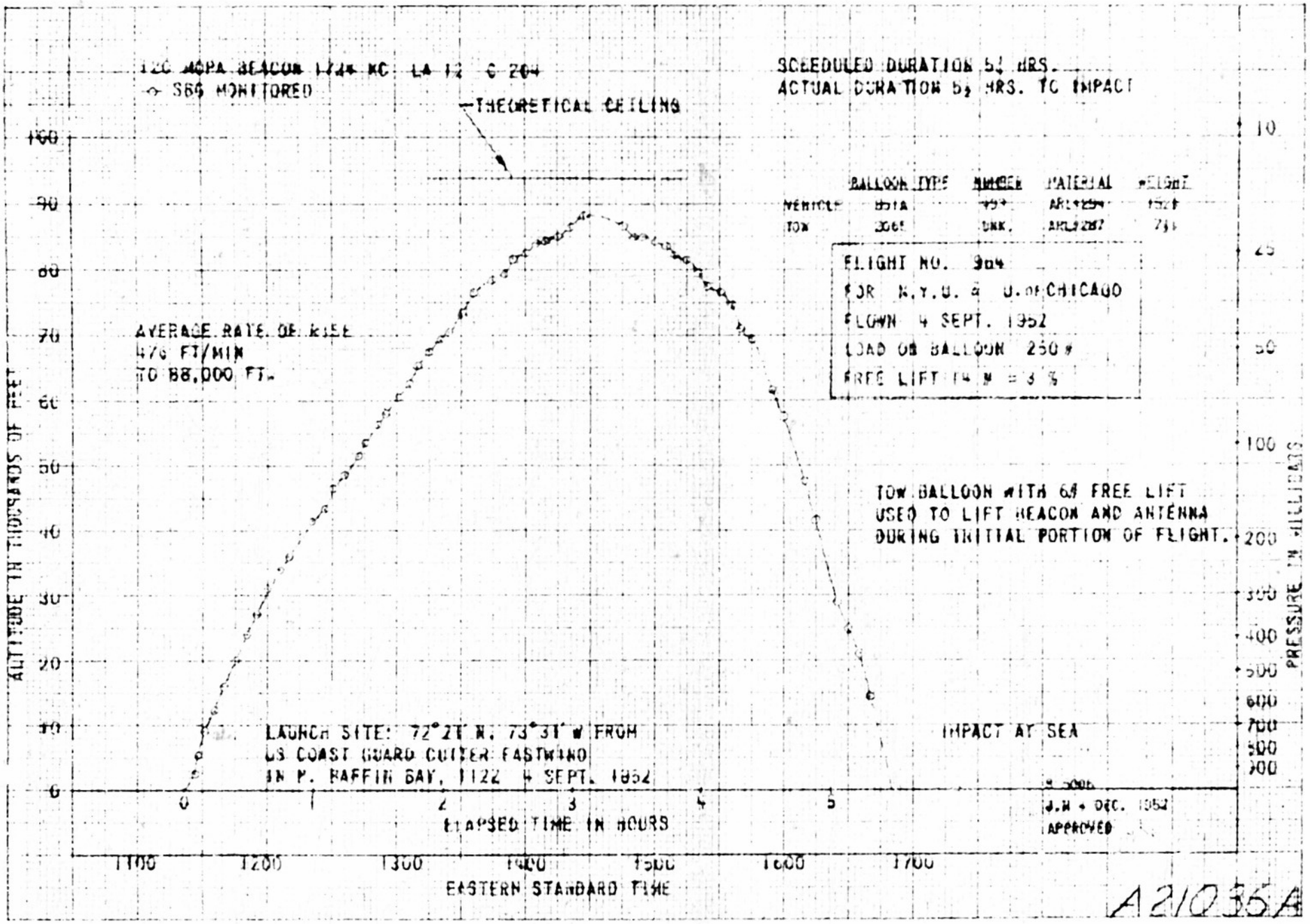
Maximum Altitude: 96,200 ft. Rate of Rise: 476 ft/min. to 88,000 ft.

Theoretical Altitude: 93,800 ft. Altitude Maintenance: None

Recovery: where? None - impact at sea

Balloon Success: Poor

Critique: Balloon launched OK, rate of rise slow but satisfactory. Did not float, but descended immediately upon reaching altitude.


120 MOPA BEACON 1744 KC LA 12 C 264
S65 MONITORED
THEORETICAL CEILING
SCHEDULED DURATION 5½ HRS.
ACTUAL DURATION 5½ HRS. TO IMPACT
BALLOON TYPE
NUMBER
MATERIAL
WEIGHT
VEHICLE
TON
3061
UNK.
FLIGHT NO. 904
FOR N.Y.U. & U. OF CHICAGO
FLOWN 4 SEPT. 1952
LOAD ON BALLOON 250 #
FREE LIFT 14 # = 6 %
AVERAGE RATE OF RISE
470 FT/MIN
TO 88,000 FT.
TOW BALLOON WITH 6# FREE LIFT
USED TO LIFT BEACON AND ANTENNA
DURING INITIAL PORTION OF FLIGHT.
LAUNCH SITE: 72°2E N. 73°3I W FROM
US COAST GUARD CUTTER EASTWIND
IN N. BAFFIN BAY, 1122 4 SEPT. 1952
IMPACT AT SEA
ALTITUDE IN THOUSANDS OF FEET
PRESSURE IN MILLIBARS
ELAPSED TIME IN HOURS
EASTERN STANDARD TIME
J.H. • DEC. 1952
APPROVED
A21035A

GENERAL MILLS, INC.
Engineering Research & Development Dept.
Minneapolis, Minn.

FLIGHT SUMMARY

Flight No.: 965 Balloon Serial No.: 21

Date: 4 Sept. 1952 Launching Time: 0955 EST Type: 1161A Weight: 276#

Who: University of Chicago

What: 105 MOPA Beacon, Gondola, Instrument Bag, Ballast Cans

Duration: Actual 1.2 hrs. to impact Load on Balloon: 104#

Gross Load: 380# Free Lift: 30# 8%

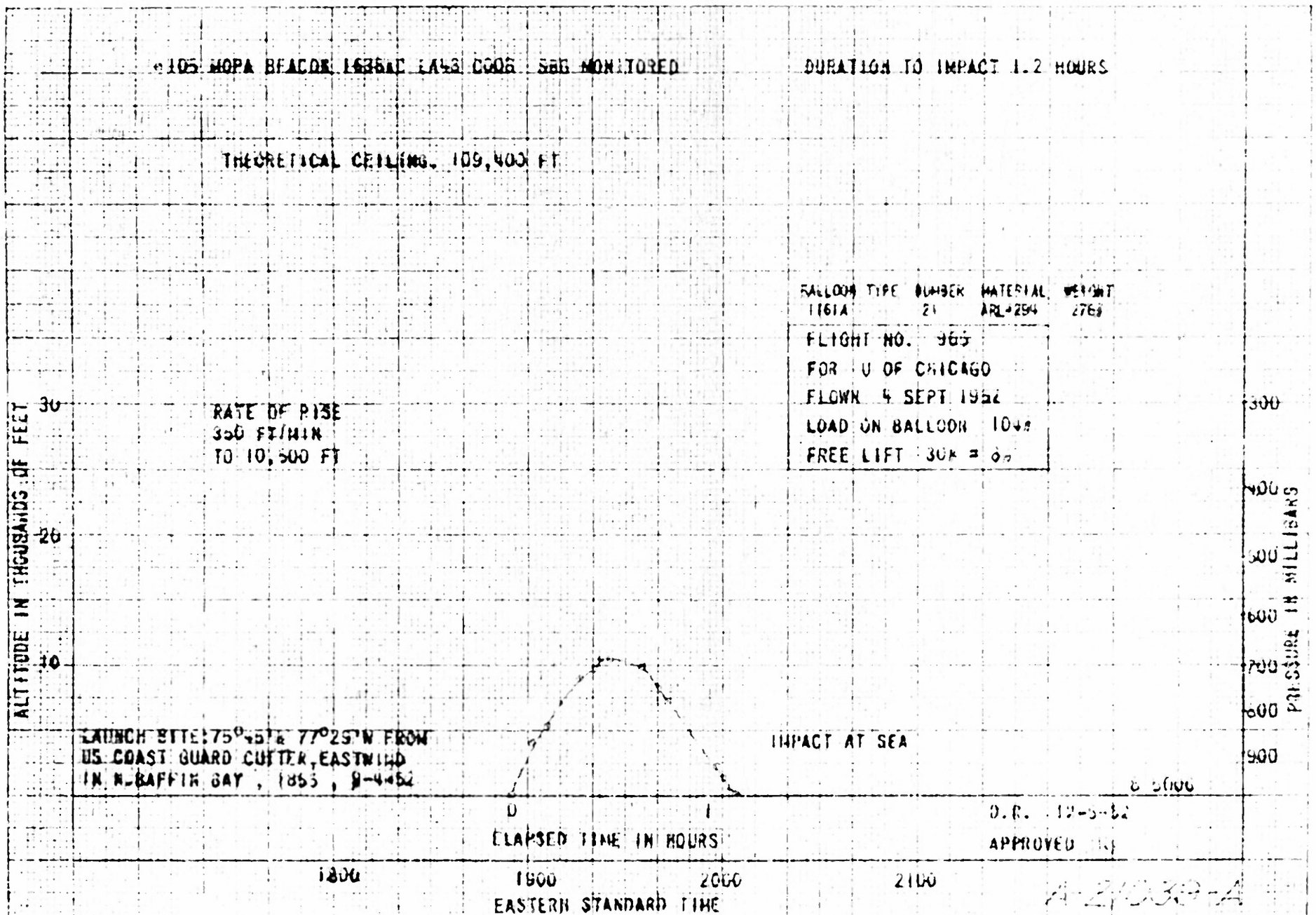
Maximum Altitude: 10,500 ft. Rate of Rise: 350 ft/min. to 10,500 ft.

Theoretical Altitude: 109,400 ft. Altitude Maintenance: None

Recovery: where? None - impact at sea

Balloon Success: None

Critique: Tow balloon left off. Excellent inflation and launch. After few minutes settled back to sea.



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