14 FEB 1968

MEMORANDUM FOR: Chief, Design and Analysis Division, OSP

SUBJECT : Post-Mission Analysis Data File
and Summaries

Problem:

The task consists of producing a post-mission summary which lists the specific targets acceptably photographed, the amount of clear, stereo photography of required "holiday" areas, and other categories of coverage in terms of film cost or efficiency.

As a tool for Post Mission Analysis, a data base of CORONA operational performance beginning with Mission 1029 (February 1966) can be generated. From this data base, appropriate summaries will be generated to indicate the _effectiveness_ and _efficiency_ of individual missions. Effectiveness refers to the specific targets and area which are acceptably photographed in meeting COMIREX intelligence requirements for the particular mission. Efficiency may be considered as the ratio of useable (in meeting requirements) to total area photographed.

Weather data (forecasts, verifications, and cloud cover conditions as determined by NPIC and/or AMS) will be included in the data base as well as in the summaries.

Together with the Area History File (AHF) these summaries are expected to bring about a better understanding of CORONA performance and capability. Also, inherent in these studies is an understanding of the operational concepts utilized.

SUBJECT: Post-Mission Analysis Data File and
Summaries

Purpose and Background:

This memorandum addresses the generation of a CORONA
Operations File (COF) and computerized CORONA mission
summaries which may be produced on a routine basis.

Several papers have been submitted on the Post Mission
Analysis task since July 1966. The present presentation is
intended to supersede all the past reports.

Summary and Recommendations:

Routine generation of CORONA operational summaries
will be more timely, accurate, and detailed than present manual
reports. Also, a single data record will be available with
several characteristics of each camera burst, i.e., number of
camera operations, number of frames, location, altitude,
amount and type of target coverage, predicted, verified, and
cloud cover conditions as determined by AMS or NPIC. In a
sense, a mission summary is a compilation of statistics from
all camera operations of that mission.

The following recommendations are made:

1. Generate a data file (COF) with a record for
each camera operation containing:

a. Operational data (film, location)

b. Target or Area Coverage

c. Cloud Cover Data

2. Generate software to produce meaningful
mission summaries from the COF. A sample summary
is presented in Table 1, and Table 2 lists possible output
data which may be presented in summary form.

SUBJECT: Post-Mission Analysis Data File
and Summaries

Discussion:

During each CORONA mission, approximately 200 camera operations which average 30 frames per operation, are selected to meet various intelligence requirements. At the time of selection, a prediction of the percent cloud-free area is available. Also, predicted is the weather (cloud conditions) above individual complexes. For each operational pass, a post-pass weather verification is transmitted to the SOC from ██████████

Although sufficient data are currently available on all aspects of a CORONA mission, the type and format as well as sources are quite diversified. This fact tends to make difficult a correlation of all the data into a concise record reflecting the mission's overall effectiveness and efficiency. Varieties of data and format are the OAK report, AMS holiday coverage overlays (no reflection of requirements are noted for these), J-Mission Priority (COMIREX), and the cloud cover estimates (forecast and post-pass) from ██████████

A method has been developed to consolidate data from several sources to produce a Camera Operations File (COF). Also, a program will be written to summarize missions based on data from the COF.

The selected data and sources are as follows:

1. J-Mission Priority

    a.   Source: COMIREX

    b.   Description:

        This document lists by priority: surveillance targets, search area (holiday and special) mapping and charting areas, and other categories such as areas of current intelligence interest.

SUBJECT: Post-Mission Analysis Data File and Summaries

2. Holiday Requirement

    a. Source: AMS

    b. Description:

These data appear on an overlay for an ASG-100 base map. Designated by perimeter are semi-annual and annual holiday requirements for the next mission.

3. Holiday Coverage

    a. Source: AMS

    b. Description:

These data appear on an overlay for an ASC-100 base map. Designated by perimeter are total coverage and clear (90-100 cloud-free) stereo area. It should be noted here, there is no indication of required area or due holiday.
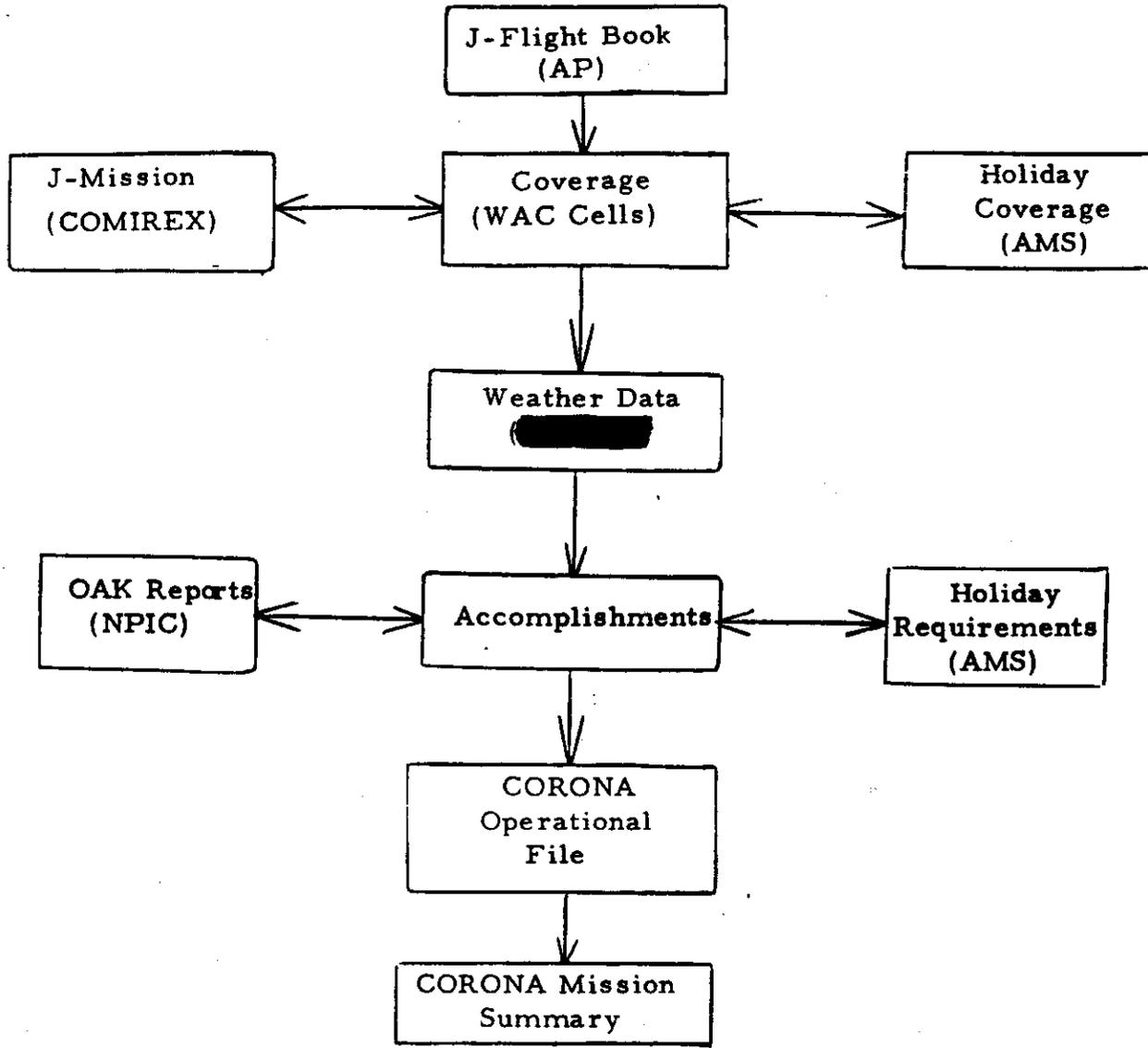
4. J Flight Book ▮▮▮▮▮▮▮▮

    a. Source: AP

    b. Description:

This document lists for each camera operation, the number of frames, stereo on location, stereo off location, altitude (on and off), range to nadir (on and off), cycle rate, and time (on and off).

Page Four

POST-MISSION ANALYSIS DATA FLOW

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                        ┌─────────────────┐
                        │  J-Flight Book  │
                        │      (AP)       │
                        └────────┬────────┘
                                 │
                                 ▼
┌─────────────────┐     ┌─────────────────┐     ┌─────────────────┐
│   J-Mission     │◄───►│    Coverage     │◄───►│    Holiday      │
│   (COMIREX)     │     │   (WAC Cells)   │     │    Coverage     │
└─────────────────┘     └────────┬────────┘     │     (AMS)       │
                                 │              └─────────────────┘
                                 ▼
                        ┌─────────────────┐
                        │  Weather Data   │
                        │                 │
                        └────────┬────────┘
                                 │
                                 ▼
┌─────────────────┐     ┌─────────────────┐     ┌─────────────────┐
│  OAK Reports    │◄───►│ Accomplishments │◄───►│    Holiday      │
│    (NPIC)       │     │                 │     │  Requirements   │
└─────────────────┘     └────────┬────────┘     │     (AMS)       │
                                 │              └─────────────────┘
                                 ▼
                        ┌─────────────────┐
                        │     CORONA      │
                        │   Operational   │
                        │      File       │
                        └────────┬────────┘
                                 │
                                 ▼
                        ┌─────────────────┐
                        │ CORONA Mission  │
                        │    Summary      │
                        └─────────────────┘
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SUBJECT: Post-Mission Analysis Data File and
Summaries

5. OAK Report

a. Source: NPIC

b. Description:

This document lists all surveillance targets
readout by NPIC for a particular mission
by target number (COMIREX) and revolution
number accessed. Also, an estimated
percentage of cloud-free area is given.

6. Weather Data ██████████████████████

a. Source: ████████████

b. Description:

These reports are estimations of cloud-
cover by *latitude within the camera swath.
Forecasts ████████ and verifications ████████
are transmitted to the SOC. Also, the
weather may be reported on a single
complex (COMIREX ID Number).

Procedure:

The method of determining access and accomplishments
for CORONA missions appears to be simplified by using WAC
cells (1:50000) as the basic accountable unit. In this manner
CORONA coverage is defined as that area within the perimeter
of a camera burst (one or more programmed camera operations).
Excellent clear (90-100 cloud-free) stereo photography is denoted
by an addition perimeter(s). The area inscribed within each
perimeter is resolved into WAC cells.

* At high latitudes, the estimated cloud cover is given in
longitude bands.

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SUBJECT: Post-Mission Analysis Data File and
Summaries

For the case of surveillance targets (J Mission Priority),
this list is converted to WAC cells geographically. As before,
the WAC cells covered by any camera operation are available
by resolving the perimeters of EFP overlays into WAC cells.
Thus access to a surveillance target is determined by matching
WAC cell numbers. However, in this case, an acceptable
photograph is indicated by NPIC in its CAR report which lists
coverage by revolution number and target identification (COMIREX).
Then a measure of accomplishment is determined by matching
those targets accessed with the CAR list.

Holiday access and accomplishment statistics are
determinable by matching coverages on the daily EFP overlays
with the pre-mission requirements overlay for the ASC-100.
In each case, all perimeters will be resolved into WAC cells.

Also, the cloud-cover estimates (forecasts and verified)
are added to each WAC cell accessed. Although these data are
stated in terms of latitude or longitude, conversion to WAC cells
is possible.

Each data record of the COF contains the information shown
in Table 2. All surveillance targets will be identified and carry
estimated cloud-cover conditions. The amount of holiday area
(total and required) accessed and accomplished is measured only
by the total number of WAC cells within each type with a mean
value for cloud-cover estimates. The four types of holiday are
required and acceptable, required and not acceptable, non-
required and acceptable, and non-required and not acceptable.

It should be noted at this point, the only useless photography
is the not acceptable areas. The non-required although acceptable
photography serves to reduce the holiday requirements for future
missions.

After the mission has been entered into the CCF a summary
is generated by collecting and averaging particular types of data
such as the number of frames per unit of holiday coverage.

SUBJECT: Post-Mission Analysis Data File
and Summaries

The efficiency of photography in the holiday category is:

$$E_i = \frac{a}{c}$$

$$\overline{E} = \frac{1}{N_t} \sum^{N_o} E_i \, N_i$$

where E_i = Efficiency of ith operation

a = Number of acceptable WAC cells in ith operation

c = Number of accessed WAC cells in ith operation

N_i = Number of frames in ith operation

N_o = Number of camera operations

N_t = Total number of frames

PROGRAMMING CONSIDERATIONS

1. WAC Cell Determination

A method is necessary to determine the WAC cells (200/50) which are included in designated are as of the EFP overlays and holiday maps. For this purpose, a routine is currently available in the Area History File (AHF) to convert perimeters from x-y coordinates to latitude/longitude. Next this program determines those WAC cells which have centroids within the bounded area.

However, a modified form of the above routine is required to convert J-mission priority points to WAC cells. The input to this routine will be a point (latitude and longitude) and a specified radius.

Page Eight

SUBJECT: Post-Mission Analysis Data File
and Summaries

2. Weather (cloud cover, forecast and verified)

A routine must be generated to convert weather data
for bands of latitude within camera swaths to WAC cells. This
problem may be solved by computation of the longitudes of swath
edges for those latitudes on which the centroids of WAC cells lie.

Prior to processing, the input weather data ██████████
██████████ must be converted to processable form.

One additional type of information, snow cover, can be
included. These data are transmitted in ██████████ in the same
format as cloud cover.

/ SIGNED

██████████
Mission Analysis Branch
Design and Analysis Division

Attachments:
1. Table 1
2. Table 2
3. Table 3

Distribution:
██████████

ORIG: D&AD/OSP: ██████████   14 February 1968

██████████

Page Nine

TABLE 1 - MISSION 1042 SUMMARY

	1042-1			1042-2			1042		
	No. of Frames	Pct	Wx Pred.	No. of Frames	Pct	Wx Pred.	No. of Frames	Pct	Wx Pred.
PR 1 (only)	7	.?	53.4	173	3.4	74.6	480	4.8	66.5
PR 1 & Other	578	6.8	71.7	593	10.1	65.4	1171	19.9	68.5
PR 2 (Only)	46	4.2	80.2	189	3.2	86.6	435	7.4	83.0
PR 2 & Other	593	10.1	62.0	646	11.0	51.3	1241	21.1	49.2
HA (Only)	455	7.8	77.2	699	12.0	77.7	1154	19.8	77.5
HA & Other	810	13.8	66.7	853	14.5	52.5	1663	28.3	59.4
HB (Only)	172	2.9	65.0	27	.5	56.1	199	3.4	63.8
HB & Other	132	2.2	73.7	---	---	---	132	2.2	73.7
MV (Only)	303	3.1	80.1	297	5.1	91.3	480	8.2	80.0
MV & Other	206	3.5	75.7	381	6.5	63.4	587	10.0	54.2
MV & MW	134	2.3	83.2	68	1.2	95	302	3.5	66.6
MW (Only)	571	9.8	92.7	339	5.8	88.5	910	15.6	91.1
MW and PR B	---	---	---	26	.4	81.5	26	.4	81.5

TABLE 2

MISSION SUMMARY DATA

I. Surveillance (point targets)

   A.   Access (unique)

   B.   Access (total)

   C.   Accomplishment (unique)

   D.   Accomplishment (total)

   E.   Efficiency (unique) (accomp/access)

   F.   **Efficiency (total) (accomp/access)**

   G.   Camera operations (total and percent)

   H.   Number of frames (total and percent)

   I.   Weather prediction/target

   J.   **Weather verification/target**

   I.   Percentage of surveillance targets within required

        holiday area. (Determined by WAC cells with dual

        requirement)

   L.   List of COMIREX targets

(TABLE 2 Continued)

MISSION SUMMARY DATA

2.* Search Coverage (Holiday)

A. **Clear, Stereo**

1. Unique

2. Total

3. Required

4. Unique and Required

B. Access

1. Unique

2. **Total**

3. Required

4. Unique and Required

C. Film Utilization

1. **No. of camera operations (percent of total)**

2. No. of frames (percent of total)

3. Average efficiency $\left(\dfrac{Clear}{Access} \right)$

4. Mean efficiency $\left(\dfrac{1}{N_1} \sum \dfrac{Clear_{N_2}}{Access} \right)$

* Data are available for each operation in a detailed list.

(TABLE 2 Continued)

MISSION SUMMARY DATA

D. **Weather data**

1. Distribution for required area

2. Distribution for total area

3. Above for prediction and verification

4. Mean deviation of prediction and

verification $\Delta W x = \frac{1}{N} \leq \left| W x_{pre} - W x_{ver} \right|$

here N is number of WAC cells.

3. **Search and Surveillance (combined)**

A. Same as 1 and 2

4. **Other Coverage**

A. Area other than that on ASC-100.

B. No. of operations (percent of total)

C. No. of frames (percent of total)

D. Weather data

1. Distribution of predicted weather by frame
   and/or operation.

2. Same for verified weather.

3. Mean deviation of prediction and verification

$$\Delta W = \frac{1}{N} \leq \left| W x_{pre} - W x_{ver} \right|$$

where N is number of WAC cells

TABLE 3

CAMERA OPERATION AND COVERAGE DATA RECORD

ITEM	SOURCE	DESCRIPTION

Camera Operation

Revolution no.		Self explanatory
Program no.		Self explanatory
Operation no.		Self explanatory
No. of Frames		Self explanatory
Cycle Rate		Frames per sec (average)
Stereo On (Location)		Latitude, Longitude
Stereo Off (Location)		Latitude, Longitude
Altitude On		Feet
Altitude Off		Feet
Slant Range on		To nadir in feet
Slant Range off		To nadir in feet

Weather

Predictions		Percent cloud-free by latitude
Verifications		Percent cloud-free by latitude

(Table 3 Continued)

Coverage

Surveillance targets:

Access	J-Mission Priority	COMIREX ID
Acceptable	OAK	priority
Predicted Wx	██████████	
Verified W:		
NPIC Wx	OAK	

Search Area

Access	AMS overlay	WAC cells, total and required
Accomp.	AMS overlay	WAC cells, total and required
Predicted Wx	██████████	WAC cells, total and required
Verified Wx	██████████	WAC cells, total and required
AMS Wx	AMS overlay	Index Photography

Other Area

Access	Calculated	(Area/frame) number of frames