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NASA TECHNICAL MEMORANDUM

NASA TM-88514

26P.

TEST PROCESSING SYSTEM (SEE)

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Translation of "Système d'exploitation d'essais (SEE), Aerospatiale Helicopter Division, pp 1-25

(NASA-TM-88514) TEST PROCESSING SYSTEM (SEE) (National Aeronautics and Space Administration) 26 p CSCL 09B

N87-15704

Unclas
G3/60 40336

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546 SEPTEMBER 1986

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1. INTRODUCTION /1*

With the increasing size of testing means and the need to qualify computer models, a test processing system was established in 1985, called SEE.

Current testing techniques, including the computer, make it possible to use many sensors and to store a very large bulk of information. This situation is changing very quickly: for example, the number of data items provided by the wind tunnel testing center of MODANE has multiplied by ten in ten years.

Moreover, the refinement of assessment (dimensioning) models and the use of computer models in work undertaken to certify our aircraft requires that computer/test comparisons be made of the maximum available test points.

The first version of the SEE system was developed in March, 1985 for the validation of the S80 (SDVEH) model. For this we used measurements from a specific campaign conducted at CEV on the SA-300: 1200 different configurations, 30 parameters measured as a function of the times sampled every 30 ms in 30 s on the average.

The version currently available is dated November 1985. Improvements were made to the SEE system to account for the requirements specific to the processing and analysis of multicyclic flights on an SA-349 and of the results of the 9th test campaign at Modane. An analysis of GIR flights to calculate the durability of elementary parts should soon be integrated with this system.

This document provides general information on the SEE system: objectives, characteristics, basic principles, general organization and processing and analysis. Based on the results obtained, the developments planned in 1986 are defined in the

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*Numbers in the margin indicate pagination in the original text.

conclusion.

Complete documentation of the SEE system may be accessed by computer using the HELP or H command:

```
H<ELP> SEE          --> MENU GENERAL (GENERAL MENU)

H<ELP> SEE          --> MENU INFORMATIONS GENERALES (GENERAL
                        INFORMATION MENU)

H<ELP> SEE          --> FORMAT DES FICHIERS (FILE FORMAT)
H<ELP> SEE TBMLEC   --> LECTURE DE BANDE MAGNETIQUE (MAGNETIC
                        TAPE READING)
h<ELP> SEE SEEEXP   --> EXPLOITATION SPECIFIQUE (SPECIFIC
                        PROCESSING AND ANALYSIS)
H<LPF> SEE LOGIC    --> LOGICIELS (SOFTWARE)
H<ELP> SEE INDEX    --> INDEX
```

2.0 OBJECTIVES /5

To define the SEE system, we set two types of objectives:

-test management,
-processing all test results.

2.1 MANAGEMENT OF TEST RESULTS

The system generally processes and analyzes the tests results and establishes a base for the data observed. The objective is to have perfect knowledge of the contents of the test campaign and to easily process the maximum number of data items obtained from these tests.

The main functions are the following:

-COLLECTE (COLLECTION): transfer, processing, transformations
-ORGANISATION (ORGANIZATION): sorting, classifying, establishing a catalog
-RESTITUTION DE L'INFORMATION (DATA PLOTTING): graphs, averages, parametric illustrations, spectral analysis, etc.

2.2 PROCESSING AND ANALYSIS OF THE TEST RESULTS

The SEE system may be easily extended to scientific applications. The development of specific tools associated with the SEE system makes it possible to automatically generate data processing and calculations and to possibly compare them with the test results. The objective is to qualify or adjust the computer model.

3. CHARACTERISTICS /6

The SEE system is installed on an IBM 3032 computer in a VM/CMS environment.

To be able to use it it is necessary:

to provide a LINK to ECMI machine disk 193.

for example: CP LINK ECMI 193 200 RR
AC 200 B/B * * B2

to have available storage of 2 M.bytes (DEF STOR 2M).

The SEE system is made up of:

-a SEE EXEC procedure written in REXX language which manages the test results and executes the modules,

-several modules (GEDIT, GEAPAC, RM, TBM, GST, AS and TRI) programmed in FORTRAN V which handle the data processing and calculations. The TEXTs are contained in the TXTLIB RCMITEXT libraries and may possibly be used to develop specific processing aids (H<ELP> SEE LOGIC)

-The graphic processing is based on LANGAGE GRAPHIQUE (GRAPHIC LANGUAGE) BASIC LGB (H<ELP> LGB) using the NOYAU GRAPHIQUE (GRAPHIC CORE).

The SEE system does not require any special knowledge on the part of the user: he should simply execute the SEE command possibly followed by the name of the campaign (example: SEE CEV) and know the basic operations provided in the XEDIT (CMS) editor.

Due to its compatibility with the CMS system, the informed user may easily combine the SEE system with other procedures to perform operations which are not provided in the system (example: RENAME, COPY, other EXEC procedures, etc.)>

SEE is a general system which may be applied to any type of test result obtained from flight testing centers, wind tunnels or ground testing centers, the only condition being that the measurements may appear in the form of a matrix; one column is associated with one measurement or one parameter defines the test configuration, one line is associated with one measuring point (H<ELP> SEE FORMAT.

Example of a file in a SEE format: /7

```
CAMPAIGN 330 CEV - VALIDATION S80
FLIGHT 29 - WIND HEADING
```

The SEE system was designed to help customize:

-the processing of the magnetic tape: format, layout, contents (H<ELP> SEE TBMLEC)

the analysis (specific processing, comparisons of calculations with tests, etc... (H<LP> SEE SEEEXP).

4.0 BASIC PRINCIPLES /8

The design of the SEE system is based on the two principles of structural relationship and modularity which are illustrated in figure 1.

4.1 TEST CLASSIFICATION

The test results are recorded in files whose identification (FILENAME, FILETYPE, FILEMODE) in an CMS environment should be made on the following principloe:

FILENAME: characters 1 to 3 --> CAMPAGNE (CAMPAIGN) (mandatory)
" 4 and 5 --> GROUPE (GROUP)
" 6 and 7 --> NUMERO D'ESSAI (TEST NUMBER)
" 8 --> INDICE (INDEX)

FILETYPE: characters 1 to 2 --> TYPE (mandatory: FT,ST,AH or AS)
following characters --> CLASSE (CLASS)

Example: CEV campaign, flight 4, test number 14a index a, function of time, level flight configuration => file: CEV0414A FTPALIER A

CAMPAGNE (CAMPAIGN): this is the set of test results belonging to the same class (example: flight tests on a certain type of aircraft, wind tunnel testing, etc.). The name of this campaign must have 3 characters (example: CEV).

GROUPE (GROUP): It qualifies the origin of the test (example: flight number, model version, etc.) and it is normally made up of two characters (example: 04).

NUMERO D'ESSAI (TEST NUMBER): it identifies the test within the group. It is normally made up of 2 characters (00 to 99) and a third character may be added to be used as an index if the same test generates several test result files (example: 14A).

TYPE: it identifies the nature of the test results and is made up of 2 characters (example: FT). Four types are presently provided by the system:

FT: tests as a function of time
ST: stabilized points (averages)
AH: results of harmonics analyses
AS: results of spectral analyses

CLASSE (CLASS): it allows the test results to be classed according to operating criteria (example: ODV, test configuration, type of measurement, etc.) and is made up of 6 characters at the most (example PALIER (LEVEL FLIGHT).

By observing and using these principles as far as possible, the user has all classification and sorting options of the SEE system at his disposal.

4.2 SYSTEM MODULARITY

The SEE system consists of an assembly of independent modules. The execution commands generated by the EXEC SEE procedure make reference to a file list with SEE option (file storage):

(module) FILENAME* FILETYPE* * SEE

The processing modules generate a new set of information from a set of tests and which may be processed by another module, which requires a perfect consistency between the different module inputs/outputs.

This open structure permits system variations and facilitates the branching of specific user operations.

5.0 GENERAL ORGANIZATION /11

The general organization of the SEE system may be summarized in the diagram depicted in figure 2.

At present, the test results processed by the SEE system may come from the testing center in the form:

-of magnetic tapes containing measurements organized according to the test configuration and as a function of time,

-of files on a disk containing:

measurements as a function of time (FT type),
mean values of stabilized points (ST type),
harmonics analysis results (AH type),
spectral analysis results (AS type).

The SEE system offers the different lists of files associated with a campaign, a group and/or a test class. Opposite each file the lists provide the title identifying the test.

Procedures are used to process these different types of data items and constitute an observed data base:

TRAITEMENT DE BANDE MAGNETIQUE (MAGNETIC TAPE PROCESSING) (TBM module) (H<ELP> SEE TBM): this procedure for transferring information to a disk enables the contents of the magnetic tape to be displayed, measurements to be sorted and converted, and disk copies to be defined.

GENERATION D'ESSAIS STABILISES (STABILIZED TEST GENERATION) (GST module) (H<ELP> PROC GST): this procedure allows you to generate stabilized points (averages) in ST type files from several tests as a function of time: FT type files. Graph plottings, definition of stabilized fields, removal of aberrant points and analysis of averages and standard deviations are provided in this procedure (example figure 3).

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ANALYSE SPECTRALE (SPECTRAL ANALYSIS) (AS module) (H<ELP PROC AS): likewise this procedure allows you to generate spectral analysis results (real-imaginary or amplitude-phase parts) in AS type files based on several function of time tests: FT type files. Graph plottings, definition of beginning of analysis time and of block size and selection of blocks provided in this procedure (example figure 4).

TRI DE RESULTATS D'ESSAIS (SORTING OF TEST RESULTS) (TRI module) (H<ELP> PROC TRI): information can be pooled from several test files complying with certain criteria (example: level flight, housefuls of weight, etc.). Automatic research of iso-values and different types of graphs help the user to define

Three other procedures allow you to process and analyze these tests:

GRAPHIQUES ET EDITIONS (GRAPHS AND EDITING) (GEDIT module): with this general procedure (H<ELP> PROC G<EDIT>), the user can manage and display the graph plottings of all variables recorded (example figures 6 and 7), generate listing print-outs, edit, copy or combine several files.

GRAPHIQUES ET EDITIONS DE PARAMETRES ASSOCIES A UNE CONFIGURATION (GRAPHS AND EDITING OF PARAMETERS RELATED TO A CONFIGURATION (GEDPAC module): this (H:<ELP> PROC GEDPAC) procedure allows you to manage the management and display operations of parameters related to a configuration by means of

interactive menus: the variables specific to a set (stabilized tests) or to a given type (harmonics or spectral analysis) are associated with variables defining the test configuration.

REGRESSION MULTILINEAIRE (REGRESSION MULTILINEAIRE) (RM module): the system calls on a general RM procedure (H<ELP> PROC RM) which allows you to adjust a mathematical model based on observed data. Here you may select the dependent variable and the independent variables, define conversions of these variables, search the optimum model using preliminary analyses of the variance and carry out the regression (example: figure 8). The results of the regression may be displayed graphically in the presence of the measuring points (example figure 9).

This procedure meets two types of requirements:

-generation of parametric metallization of phenomena observed which may then be introduced in a computer program,

-smoothing allowing you to obtain synthetic graphic representations: showing the influence of a parameter, establishing charts, etc.

6.0 PROCESSING AND ANALYSIS /21

The user who wants to extend the SEE system to its specific applications should develop an EXEC SEEEXP procedure which handles the following actions: (H<ELP> SEE SEEEXP)

Recovery of the arguments given by the SEE system, these tell you the campaign, group, type and class of the tests selected by the user.

Interactive menus which may depend on the nature of the testing (the type of testing in particular) allowing the user to select his applications.

Two types of applications may be defined:

CALCULS (CALCULATIONS): the system generates the data required for calculations based on selected tests and also provides the results presented in the form of a listing or diagram (example: EV polar). This is a sophisticated conversion of the measurements.

COMPARISONS CALCULS/ESSAIS (CALCULATION/TEST COMPARISONS): the purpose is to show the test and calculation results on the same graph as well as statistical data which allow you to determine how closely the model coincides with reality this technique which is useful for qualifying or adjusting computer models facilitates this comparison work by automatically generating the data required for the calculations and by easily comparing the test and calculation results. In this regard, it is a considerably aid to the engineer who develops and perfects a modelization: it may in particular measure the impact of a model alternation quickly and systematically (see figures 10 and 11).

7.0 CONCLUSIONS

In 1985, the SEE system was primarily used for processing and analyzing 3 test campaigns:

-QDV tests on an SA 330 at CEV,
-multicyclic tets on an SA 349,
-wind tunnel testing at Modane (9th campaign).

These applications demonstrated:

-the general nature of the SEE system,
-the testing management and processing options,
-the adaptations to specific operations such as:

-validating the S80 simulation model (doc. H/DE.Ec 052/85),

-calculating stresses at the rotor head (ECV).

The documentation prepared in connection with descriptions and examples of application should make it possible to distribute the SEE system extensively. As of now, it is planned to include the following in this system:

-processing and analysis of the aerodynamic characteristics measured in a wind tunnel (ECA),

-analyzing GIR flights to calculate service life (ECM),

-validation of rotor models (rotor EC group),

-validation of the simulation power model used for certification (ECA).

At the same time, it will be necessary to contact the testing centers (EV, ES wind tunnel, Modane, etc.) to define together the test contents and techniques which are the most compatible with the processing and analysis to be accomplished by the SEE system. This pertains to: /25

the contents of test requests: definition of the experiment plan, verifications made during the tests, etc.,

the system of annotations which must be standardized to be usable by data processing systems: sys tems of axes, names of variables, units, etc.

establishing data processing links, definition of read/write formats, support (disks, magnetic tapes), etc.

It would be desirable to install the SEE system with the required adaptations in the testing centers to make sure that information provided complies with agreements and standardizations, to provide for consistency in data processing aids and to thereby limit the risks of errors.

The SEE system will develop as a function of user requirements. In particular, static functions such as histograms, variance analysis with 1 or 2 effects will be included in the SEE system.

Given the extent of the requirements, this work will be given first priority for the ERIS service and special effort will be devoted to them in 1986.

TEST CLASSIFICATION

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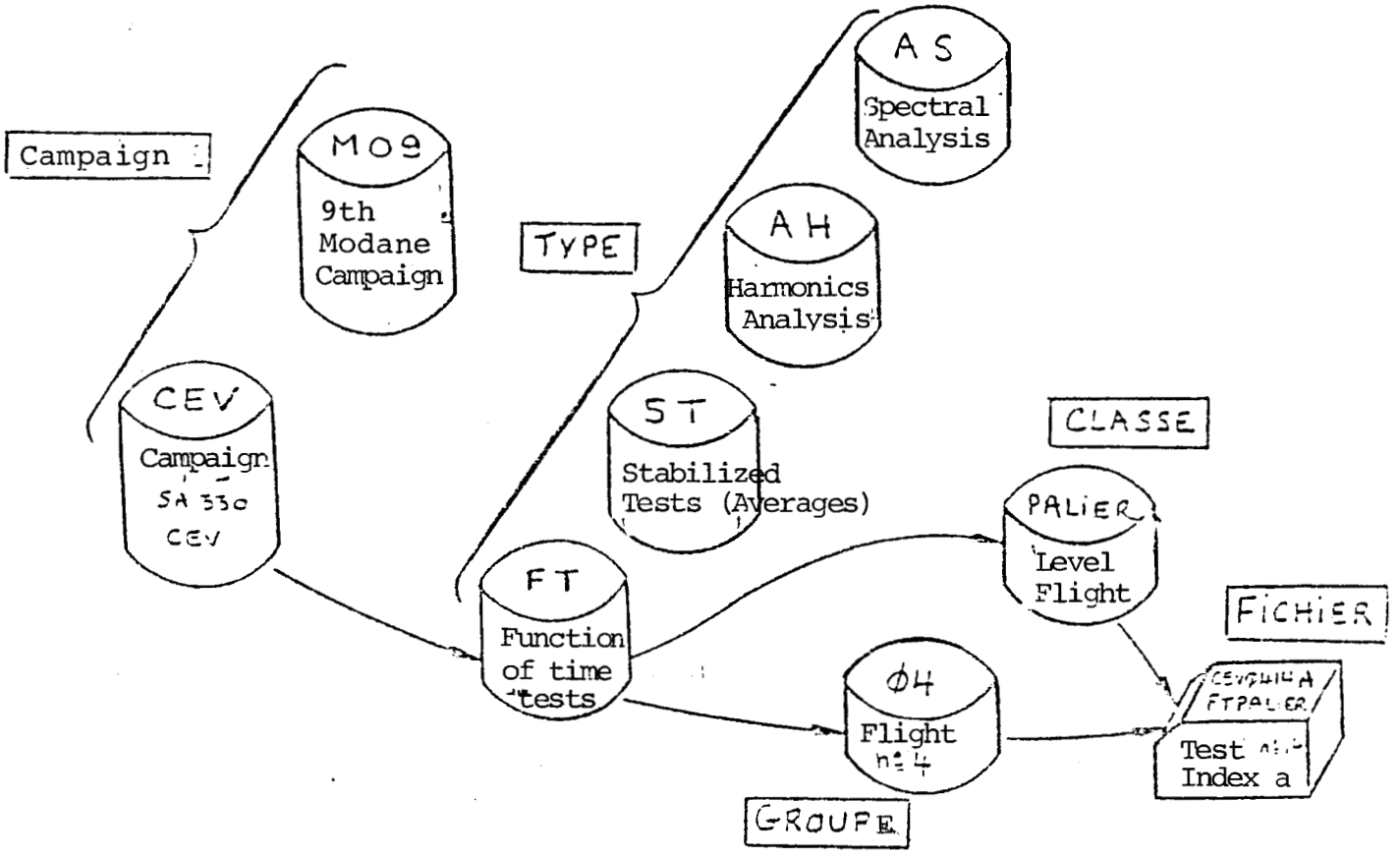

SYSTEM MODULARITY

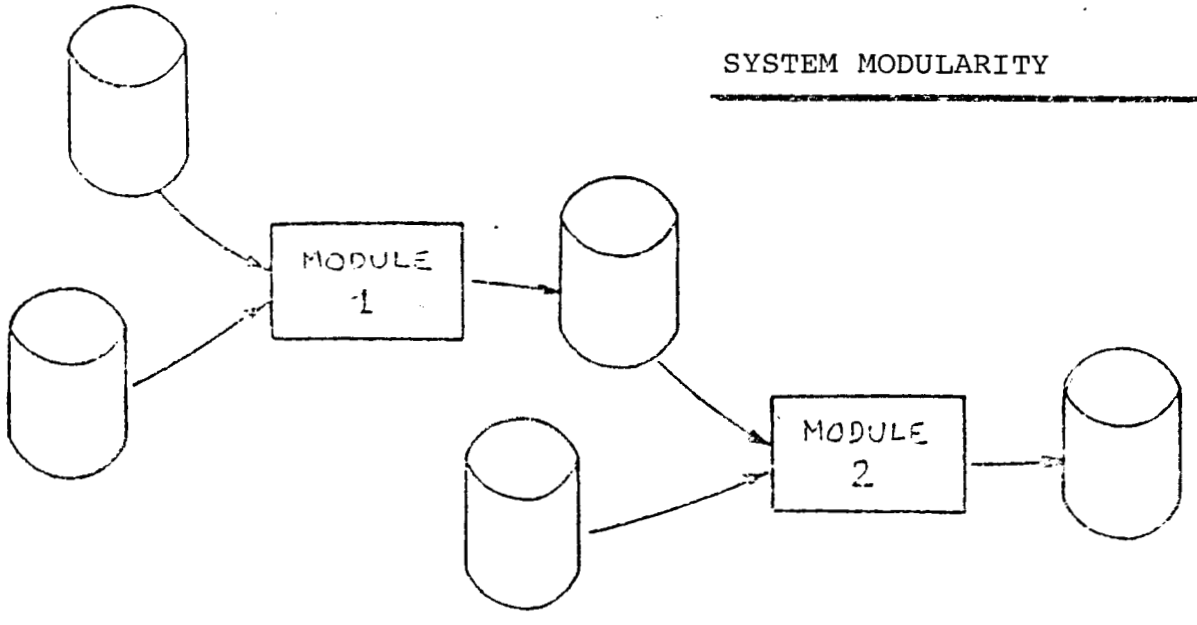

FIGURE 1

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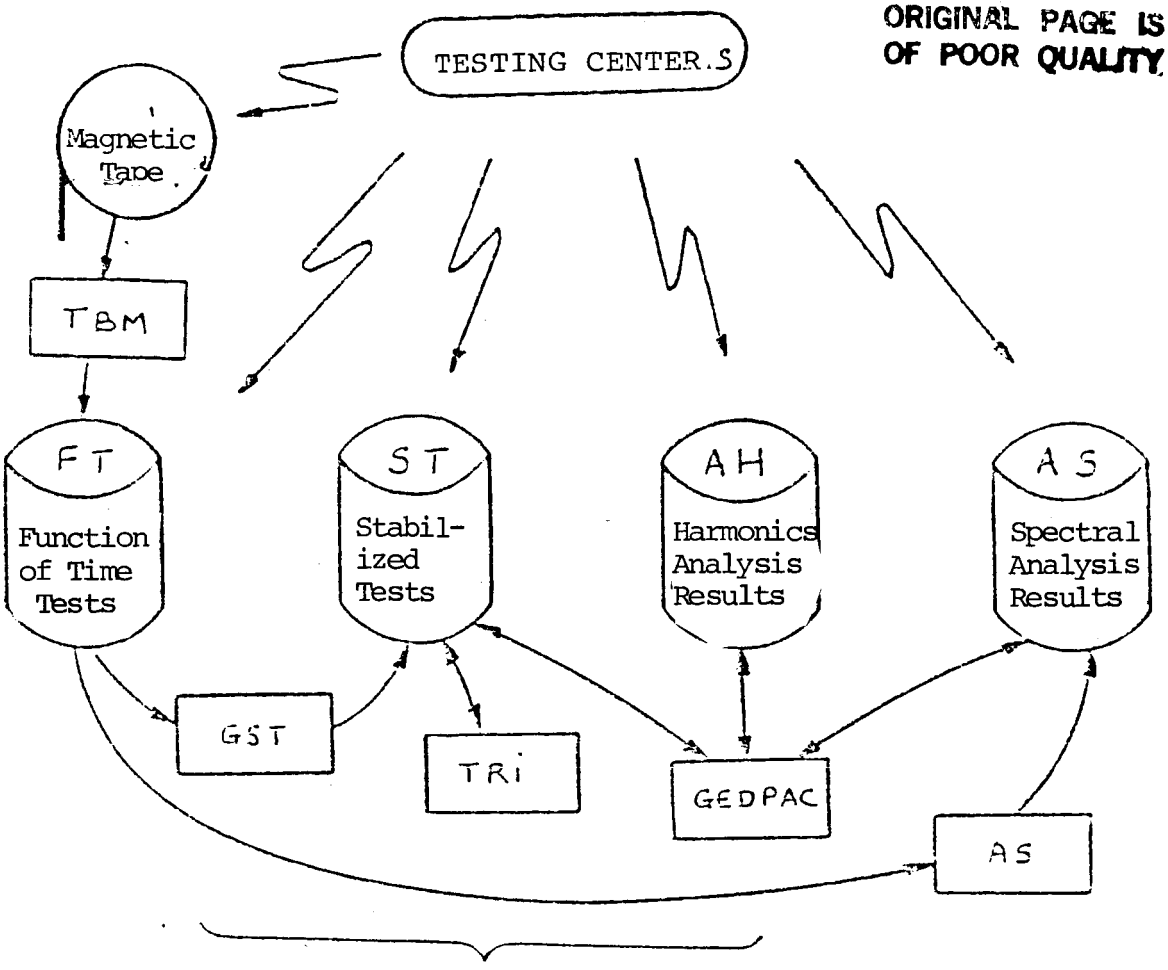

TBM : Magnetic Tape Processing

GST : Generation of Stabil-ized Tests

TRI : Sorting of Test Results;

GEDPAC: Graphs and Editing of Configuration-Related Parameters

AS : Spectral Analysis

GEDIT: Graphs and Editing

RM : Multilinear Regression

SEEEXP: Exec User Procedure (Specific Operations)

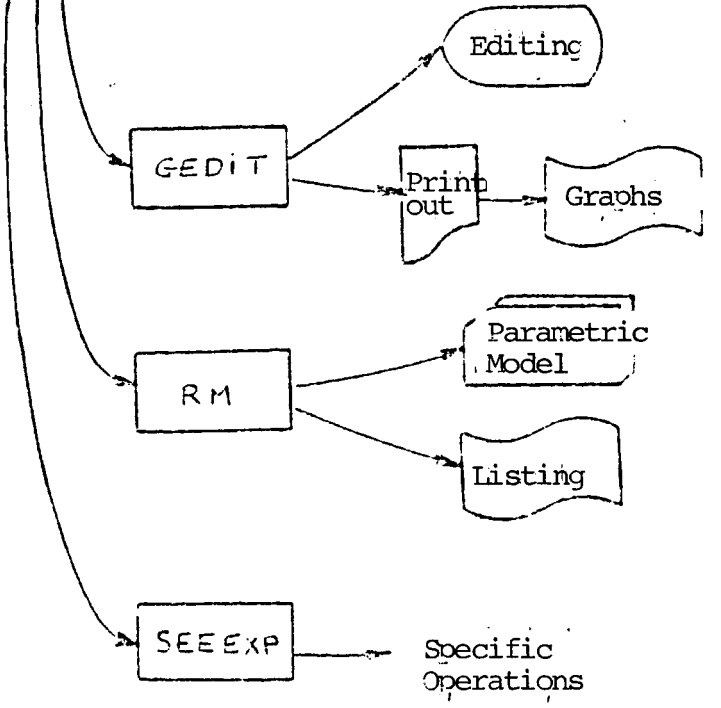

FIGURE 2 - GENERAL ORGANIZATION

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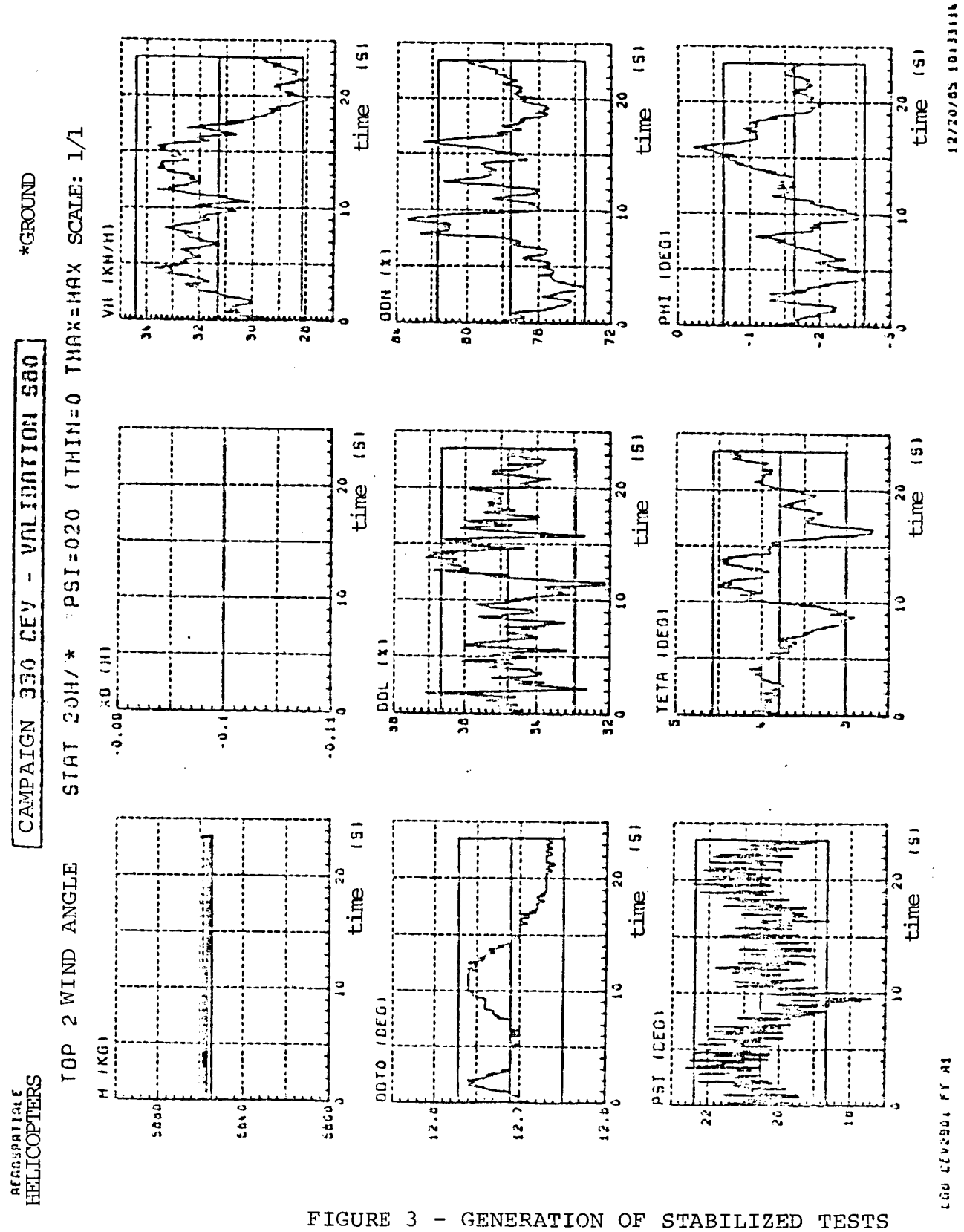

FIGURE 3 - GENERATION OF STABILIZED TESTS

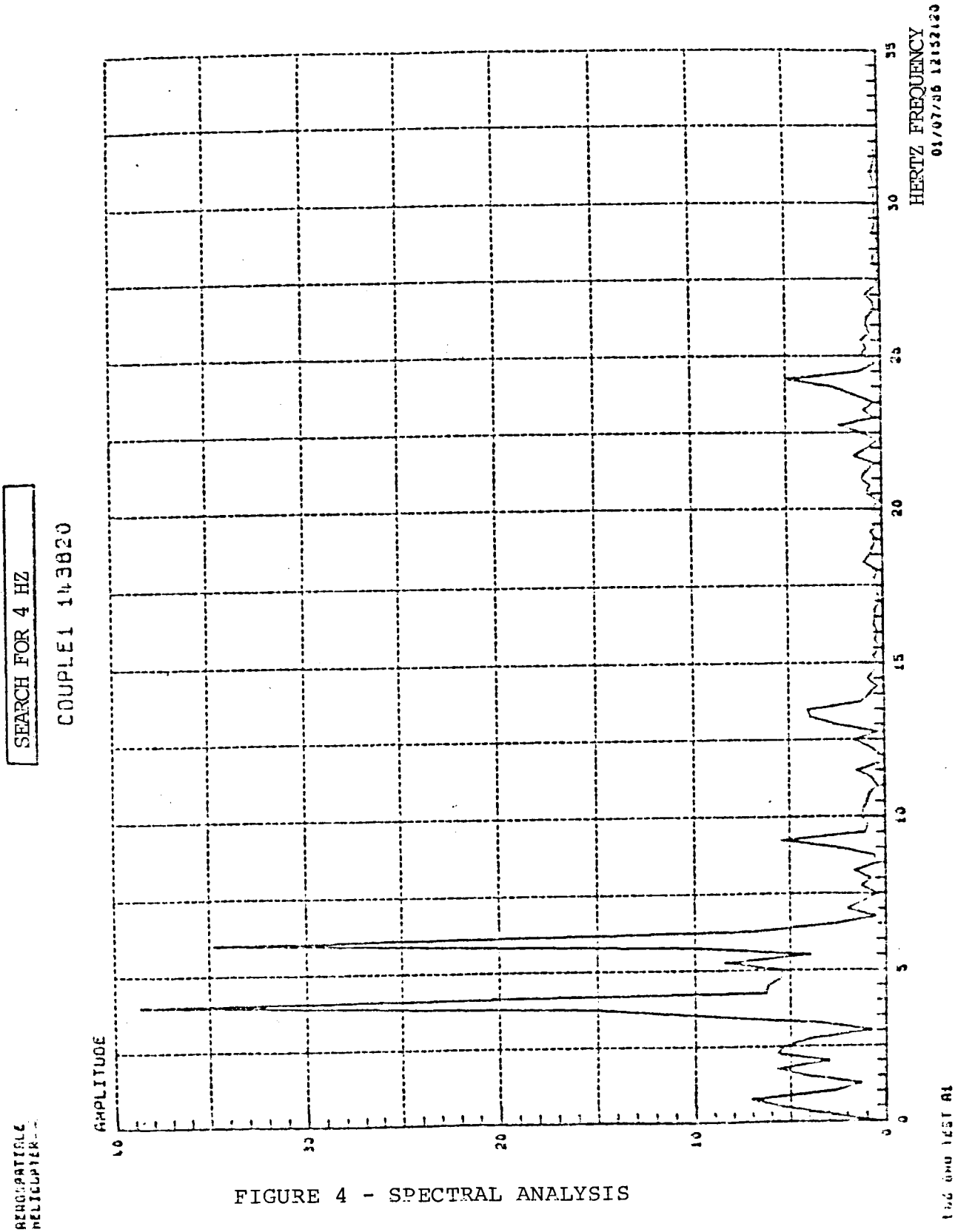

FIGURE 4 - SPECTRAL ANALYSIS

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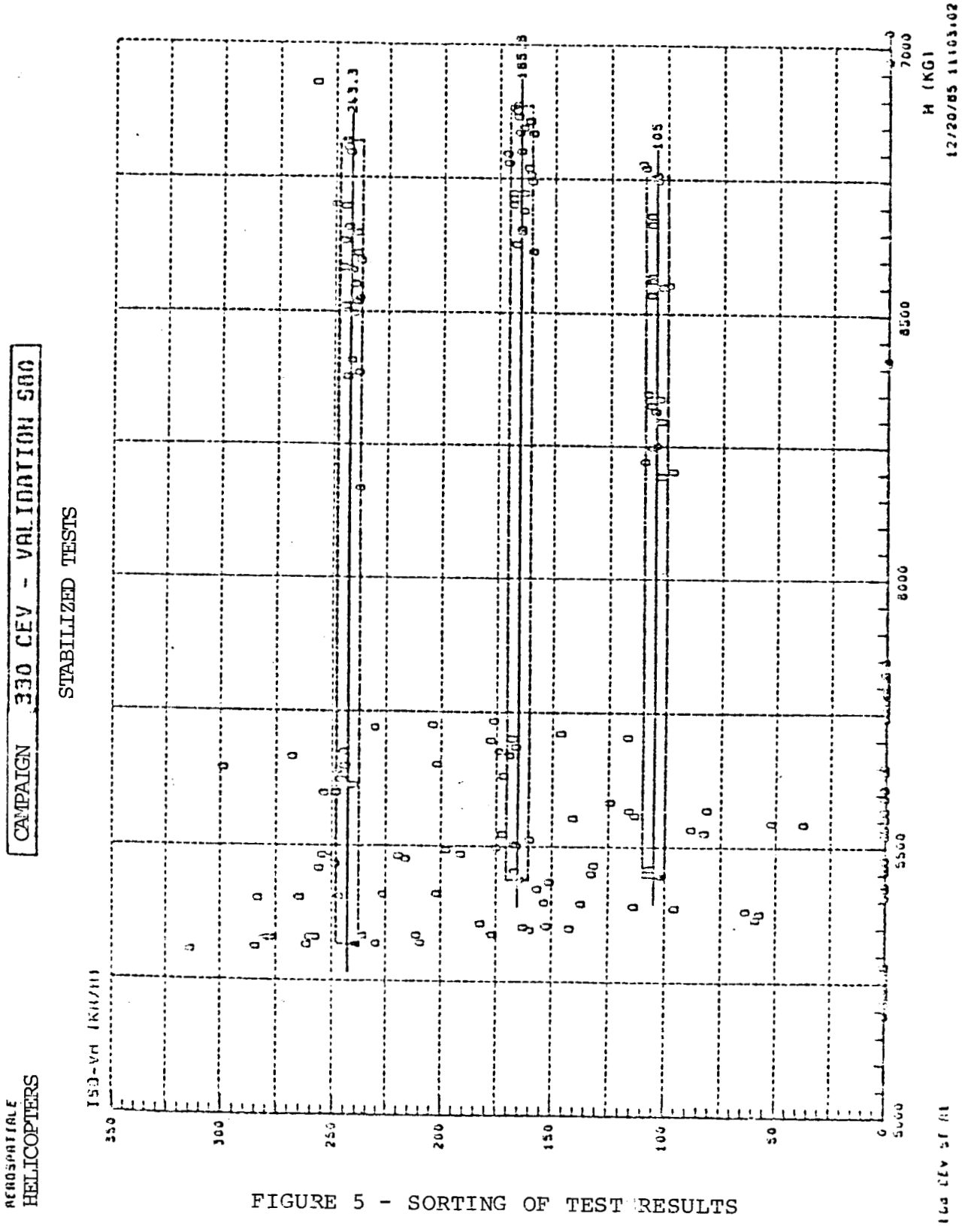

FIGURE 5 - SORTING OF TEST RESULTS

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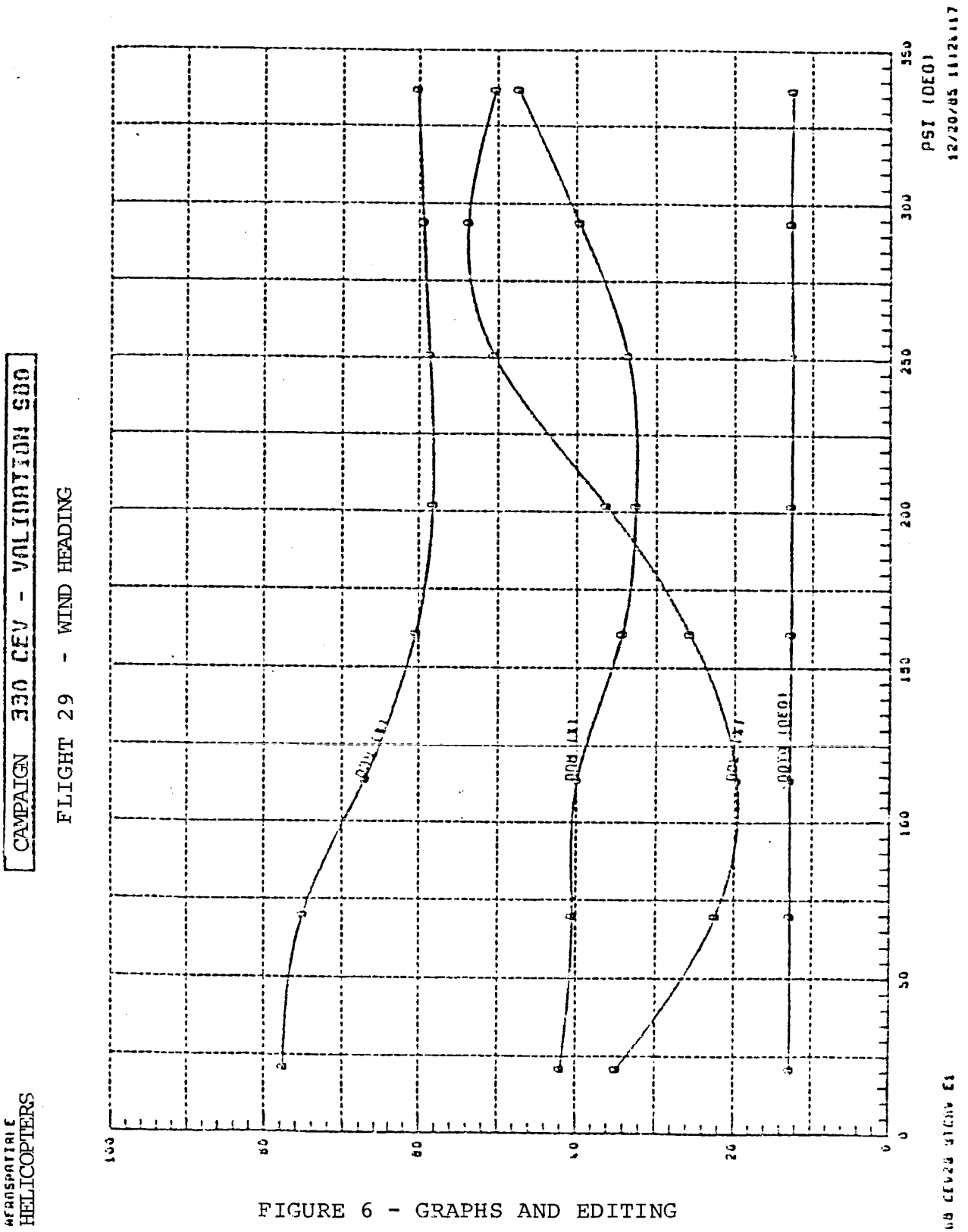

FIGURE 6 - GRAPHS AND EDITING

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AEROSPATIALE
HELICOPTERS

CAMPAIGN 330 CEV - VALIDATION 580

FLIGHT 29 - WIND HEADING

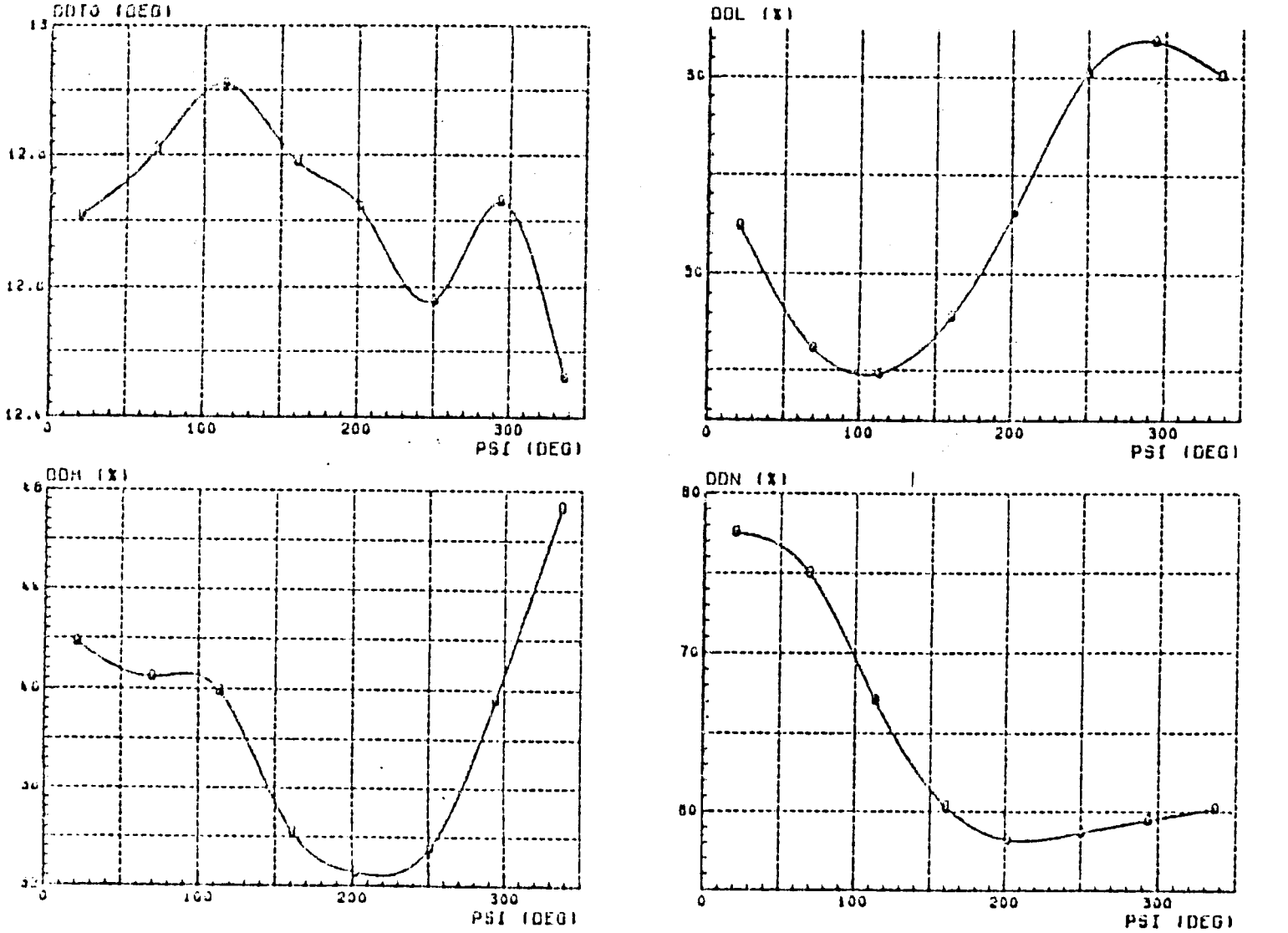

FIGURE 7 - GRAPHS AND EDITING

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CAMPAIGN 330 CEV - VALIDATION S80
FLIGHT 29 - WIND HEADING
STATISTICAL INFORMATION ON VARIABLES

Number of points: 8

Nr	VARIABLE	MINIMUM	MAXIMUM	AVERAGE	VARIANCE	STANDARD DEVIATION
	ODL	19.59	53.74	36.67	183.3	13.54
1	SIN(PSI+0.017)	-0.9609	0.9364	-0.00884	0.5063	0.7857
2	COS(PSI+0.017)	-0.959	0.9338	-0.02759	0.5556	0.7454
3	SIN(PSI+0.017)**2	0.0803	0.9234	0.5131	0.147	0.3834

CAMPAIGN 330 CEV - VALIDATION S80
FLIGHT 29 - WIND HEADING
ADDITION OF VARIABLES PER LEVEL FLIGHT

Nr	VARIABLE	Square S	Av.	ODL	R2%	F(1,ODL)	P%	
	ODL	1283						
1	SIN(PSI+0.017)	1197	86.28	6	93.3	83.24	0	HS
2	COS(PSI+0.017)	1281	2.179	5	99.8	193	0	HS
3	SIN(PSI+0.017)**2	1281	2.05	4	99.8	0.2511	64.3	NS

CAMPAIGN 330 CEV - VALIDATION S80
FLIGHT 29 - WIND HEADING
VARIANCE ANALYSIS

SOURCE	SQUARE S	DOL	*	./DOL	R2%	F(2, 5)	P%	*SQUARE S
ODL	1283	7						
REGRESSION	1281	2	640.6		99.8	1473	0	HS
RESIDUE	2.179	5	0.4357					

CAMPAIGN 330 CEV - VALIDATION S80
FLIGHT 29 - WIND HEADING
VARIANCE ANALYSIS

Nr	VARIABLE	COEFF.	INTERV. DE CONF. 5%		T.STUDENT	P%	
	ODL						
	CONSTANTE	36.65	36.05	37.25	156.9	0	HS
1	SIN(PSI+0.017)	-15.39	-17.33	-16.15	52.14	0	HS
2	COS(PSI+0.017)	4.651	3.79	5.512	13.39	0	HS

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FIGURE 8 - MULTILINEAR REGRESSION

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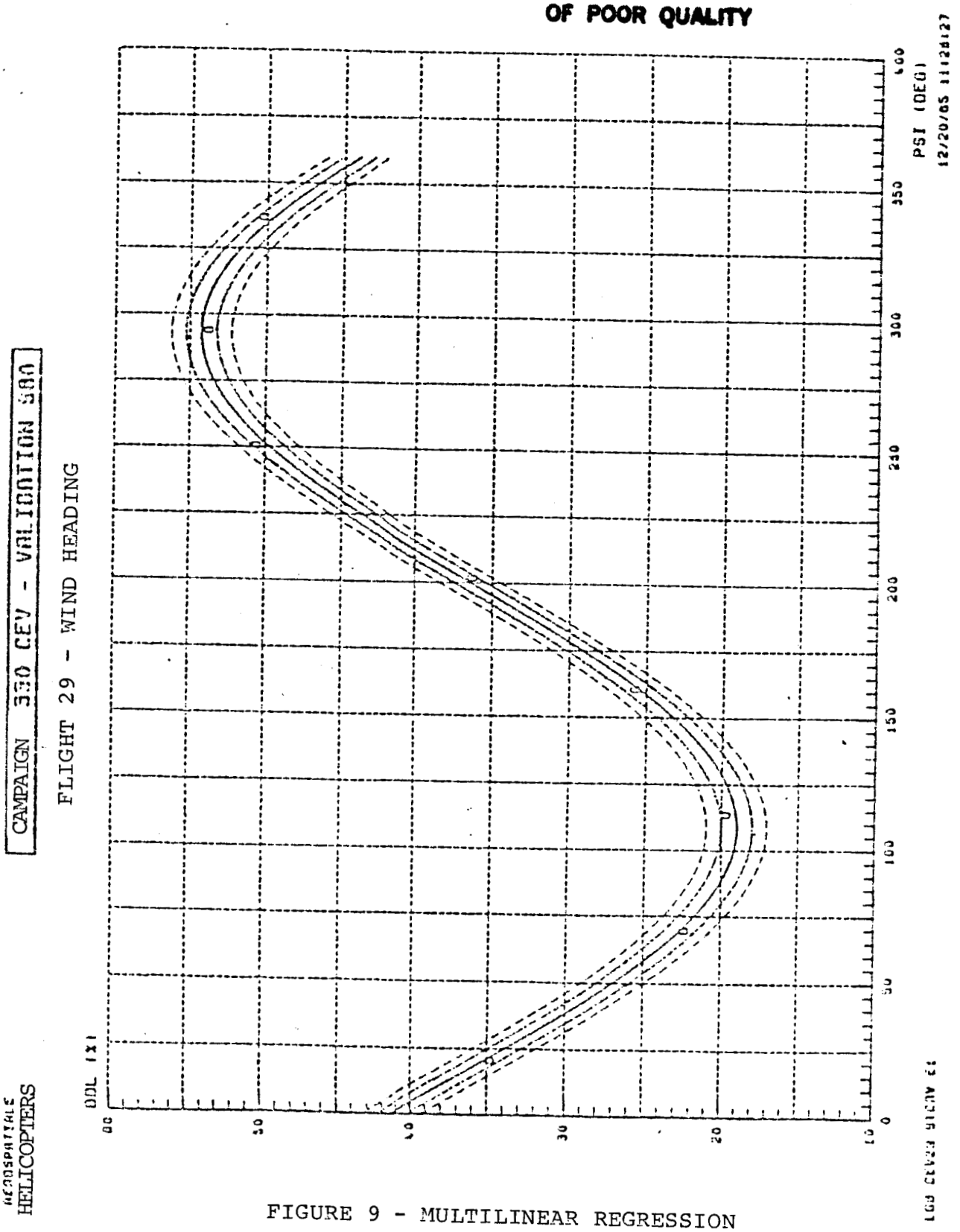

FIGURE 9 - MULTILINEAR REGRESSION

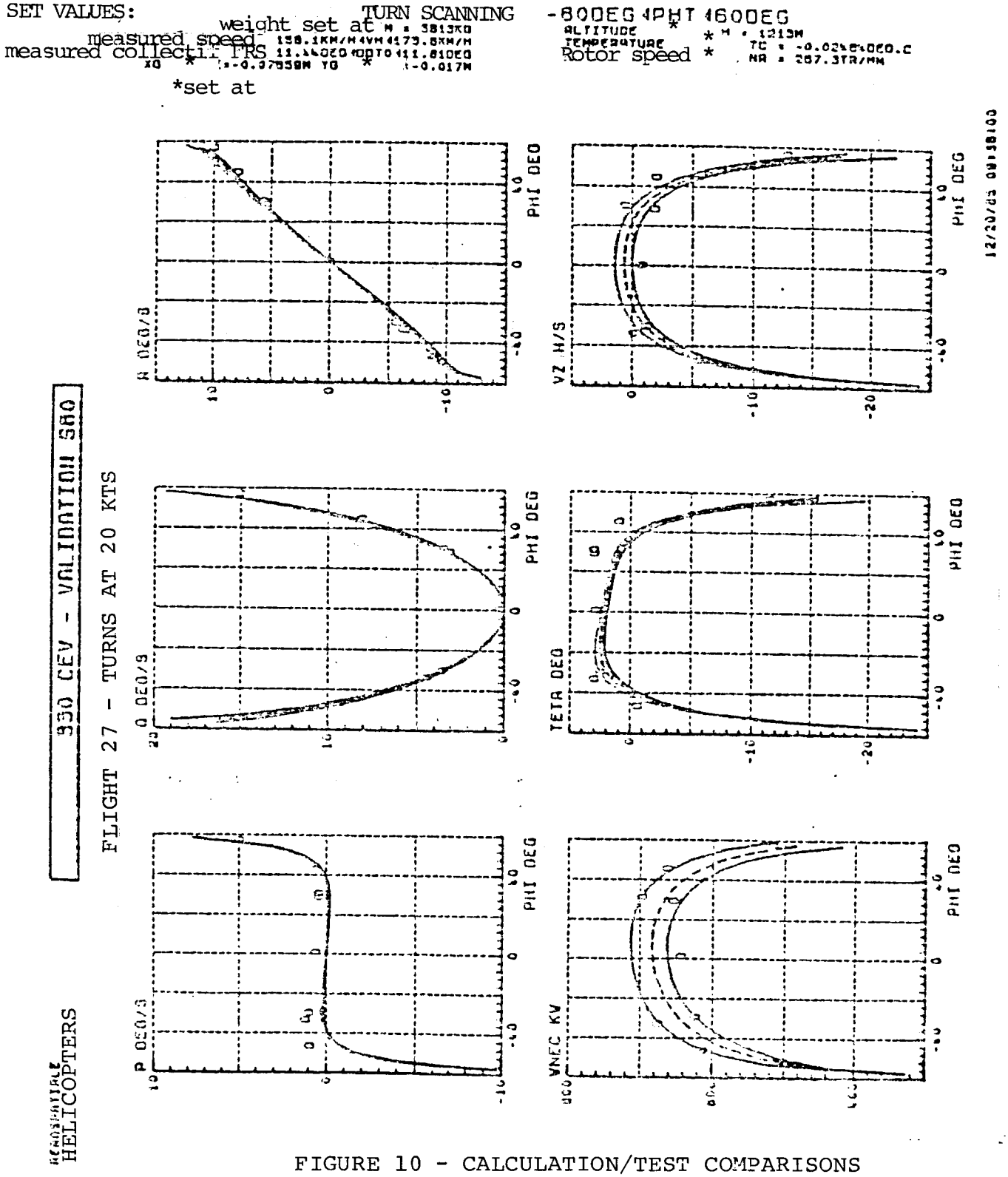

FIGURE 10 - CALCULATION/TEST COMPARISONS

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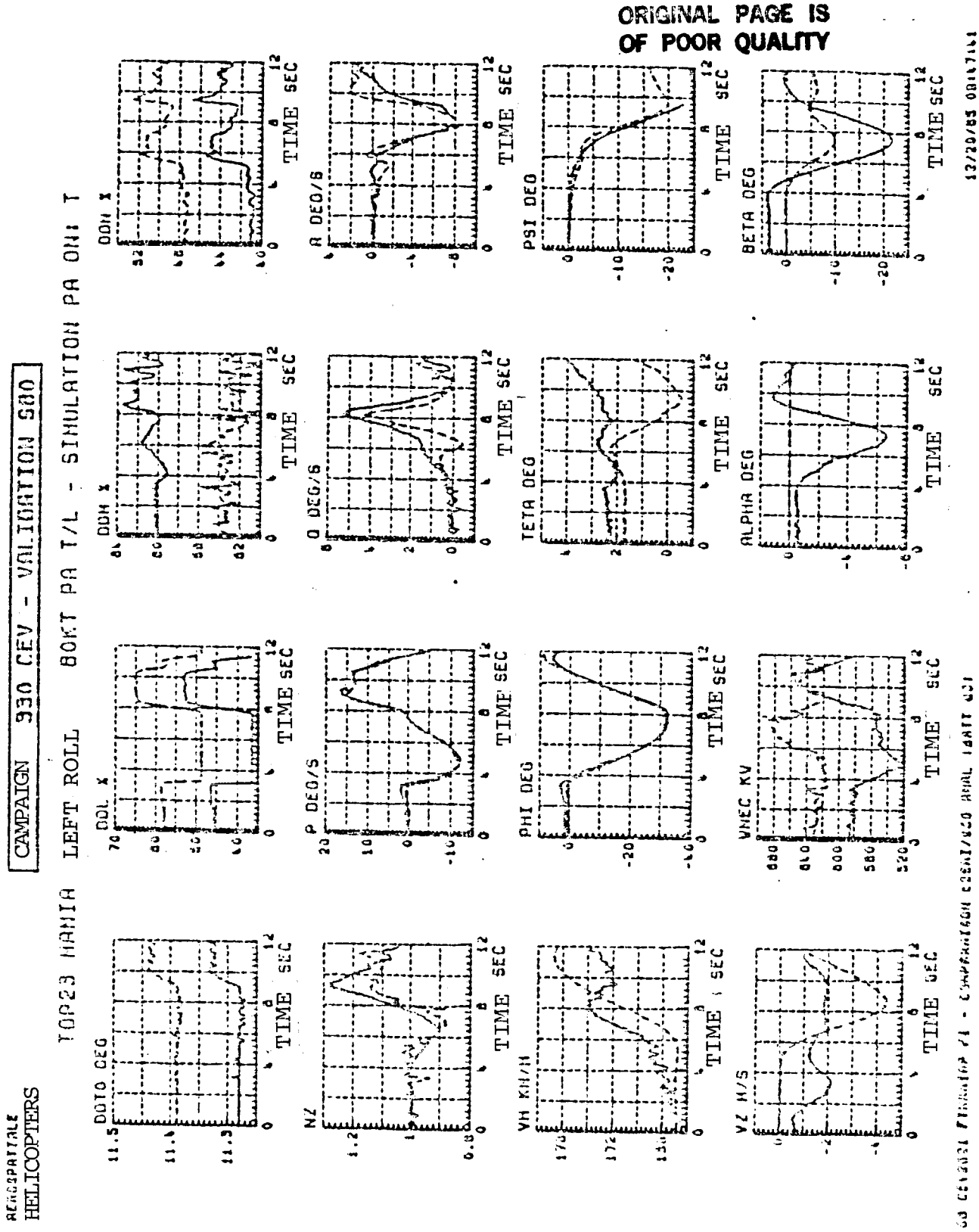

FIGURE 11 - CALCULATION/TEST COMPARISONS

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STANDARD TITLE PAGE

1. Report No. NASA TM- 88514	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle TEST PROCESSING SYSTEM (SEE)		5. Report Date September 1986 6. Performing Organization Code
7. Author(s) P. Gaulene		8. Performing Organization Report No. 10. Work Unit No.
9. Performing Organization Name and Address Leo Kanner Associates Redwood City, Ca 94063		11. Contract or Grant No. NASw-4005 13. Type of Report and Period Covered Translation
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration, Washington D.C. 20546		14. Sponsoring Agency Code

15. Supplementary Notes

Translation of "Système d'exploitation d'essais (SEE), Aerospatiale Helicopter Division, pp 1-25

16. Abstract

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17. Key Words (Selected by Author(s))	18. Distribution Statement
	Unclassified-Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22.
Unclassified	Unclassified		