3 MARCH 1980 (FOUO 3/80) 1 OF 1

JPRS L/8961

3 March 1980

West Europe Report

SCIENCE AND TECHNOLOGY

(FOUO 3/80)

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WEST EUROPE REPORT

SCIENCE AND TECHNOLOGY

(FOUO 3/80)

CONTENTS PAGE

DIFFICULTIES WITH INITIAL 'ARIANE' LAUNCH REVIEWED

15 December Launching Attempt

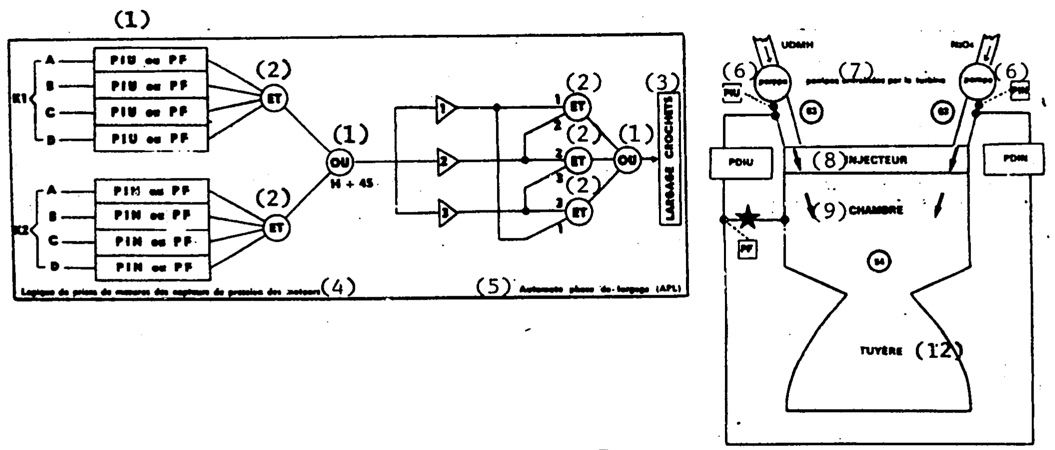
Paris AIR & COSMOS in French 12 Jan 80 p 34

[Text] At the first launching attempt, of 15 December, the launch countdown went normally until the firing of the engines of the first stage and even beyond, since the launch was halted only a few fractions of seconds before the opening of the stanchions to release the "Ariane" rocket. This is all the more regrettable because the rocket was functioning perfectly and could have taken off at the first go!

The incident that caused this "aborted launch" was a piece of false information from the operating-pressure pickups of one the four engines of the first state; the false information was detected after the firing (at H + 2.8 seconds) but before the takeoff of the rocket. The computers of the control bench therefore interrupted the launching sequence by stopping the four engines (8 seconds after ignition) and by interdicting the release (planned for H + 4 seconds) of the stanchions that hold the rocket to the ground.

In effect, if the information received by the computers had been correct (pressure drop in one of the engines), the rocket could not have taken off normally: as soon as it was free of the stanchions, it would have fallen down and would have exploded, thereby causing the destruction of the launch pad. It is precisely to avoid such a catastrophe that the information from the operating-pressure pickups of the first-stage engines is thus taken into account in the final launching sequence. These pickups are also the only ones in the rocket that play such a role.

The differential pickups measure a pressure difference in a relatively narrow range (-5 to +15 bars) in the following way: one of them compares the base pressure of the combustion chamber with the pressure of UDMH [unsymmetrical dimethylhydrazine] injection into the engine, and the other compares the same base pressure with the nitrogen peroxide (N_2O_4) injection pressure, the injection pressures being picked up at the outlet end of the pumps (see diagram). The nominal value of this difference during measurement (between H + 2.8 seconds and H + 4 seconds) is 9 bars--that is, the



(11) **Capteurs de pression du moteur "Viking"**

Absolute-pressure pickups--for base pressure (PF) and fuel-injection pressure (PU, PIN)--and differential-pressure pickups (PDIU and PDIN). Star marks site of incident.

[Key]:

1. Or
2. And
3. Release of stanchions
4. Measurement logic of engine pressure pickups
5. Automatic release-phase device
6. Pump
7. Pumps driven by turbine
8. Injector
9. Chamber
10. Nozzle
11. Pressure pickups of "Viking" engine

---

difference between the base pressure (54 bars) and the fuel-injection pressure (63 bars), which are identical, since the pumps of each fuel line are driven by the same turbine.

When the rocket's engines were started up at Kourou, the pressure measurements for three engines (B, C, D) were nominal, but the measurement for the fourth engine was clearly beyond the limits fixed in the computer, which therefore stopped the firing. In reality, all the engines were functioning normally. The anomaly came solely from the pickups of engine A, which had been damaged by a local overpressure occurring in their feed line at the moment of ignition. This overpressure, caused by the microcombustion of a few drops of nitrogen peroxide and UDMH in the small-diameter (4 mm) feed tubing, completely deteriorated the membranes of the pickups, rendering them unusable. But this fact could not be detected at the moment.

However, the phenomenon was known. It had already occurred on the occasion of the first firing of a set of four first-stage engines at Vernon. At that time, the setting of the engines' fuel supply was adjusted, and nearly complete disappearance of the phenomenon was observed: it did not occur on such a large scale in the 20 test-bench firings subsequently carried out.

It occurred again on the occasion of the first firing at Kourou, doubtlessly as a result of the different configuration of the launcher on its launch pad. Nevertheless, the incident should not have been of such proportions. But it was established that there was not compete redundance of the measurement made by these two pickups, for they were fed by the same pipeline (so as to make only one hole in the chamber!).

To avoid repetition of this incident on the following attempt, the CNES [National Center for Space Studies] therefore decided to stop taking into account the measurement from the differential pickups (kept in place, with new pickups, so as not to disturb the system's configuration), but rather to use the data from the other three absolute-pressure pickups, measuring, respectively, the base pressure and the UDMH and N_2O_4 injection pressures, and to do so with measurement thresholds expanded from the initial limits (measurements at 75-percent pressure instead of 90 percent). For this purpose, it was sufficient to modify the wiring of the measurement circuits without doing anything to the logic, in order to to the Automatic Release-Phase Device (APL) the data enabling it to deliver the final orders authorizing launcher takeoff.

On the other hand, the measurement logic had been modified (see diagram) to take account this time of the absolute values of the base and injection pressures; the use of this new logic with the measurements (on tape) of the aborted launch had shown that under these conditions, release should have been authorized--as was confirmed by the successful launch of 24 December.

23 December Launch Attempt

Paris AIR & COSMOS in French 12 Jan 80 p 36

[Text] Two consecutive incidents occurred during the second launch attempt, on 23 December, the second incident, which led to postponement of the launching, having been induced by the first one.

The first incident occurred at H - 55 seconds: thus at the very last instant of the synchronized sequence before the ignition of the engines. It was caused by the absence of transmission to the computers of the charge voltage of a battery on board the launcher that powers mainly the on-board telemetry. Therefore, as was provided for, the control-bench computers caused the "return to initial configuration" (RCI) of the launcher, for resumption of the countdown at H - 6 minutes.

It was quickly established that the battery was functioning normally (as on the preceding attempt) and that its charge voltage was good. The incident was in fact due to a device called INCA (Cannes Digital Interrogator), which makes the voltage measurements and transmits them to the control computers. This piece of equipment had already caused the officials in charge some concern about its ability to obtain the first battery-voltage measurement and deliver it to the computers in the time available. It had therefore been decided, on the occasion of the project review preceding the L01 first firing, that the INCA would send to the computers the second voltage measurement, which could definitely be delivered in time. But for lack of time, this modification could not be made for the first lauching; but it will be done for the L02 second launch.

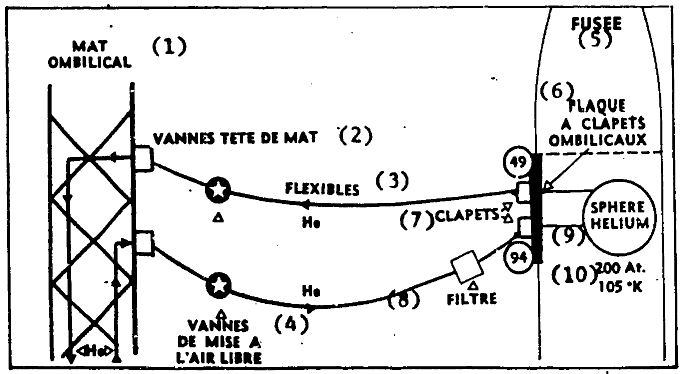
For the following launch attempt, it was therefore decided to do without the voltage measurements furnished by the INCA--that is, do without the other three measurements of the same "key time" also (sequence of operations to be done within a specific time period)--for the voltage measurements could not be isolated by themselves without modifying the logic of the computers, which was obviously out of the question on the eve of a launch. However, an operator was assigned to watch these other three measurements (INCA excepted) closely and to stop the countdown manually if an anomaly arose.

But the incident with the INCA caused a second one, far more serious.

The fact is that return of the launcher to initial configuration requires numerous operations, including restoration of circulation of helium (used to pressurize the third-stage tanks on the ground) between the spherical tank on board and the supply source on the ground. The purpose of this is to avoid overheating of the helium, with the risk of explosion of the sphere under pressure (200 bars).

To carry out this operation, the valves on the tower head and the clack valves on the third-stage plate are opened to establish helium circulation: the helium sphere, warmed by the ambient temperature, is emptied, and cold helium at 105° K is sent into it (see diagram). On 23 December, the emptying went normally, but a pressure loss of about 70 bars in the circuit for supplying the sphere with helium under pressure was immediately noted, as if the helium-intake clack valve or the filter were blocked.

After several attempts to reestablish helium circulation with the sphere, the operations chief decided to postpone the launching to the next day, since the weather forecast was in any case too poor to permit launching on that day within the time frame available (5 hours).



[Key]:

1. Umbilical tower
2. Tower-head valves
3. Flexible tubes
4. Valves for release into air
5. Rocket
6. Umbilical clack-valves plate
7. Clack valves
8. Filter
9. Helium sphere
10. 200 atmospheres, 105° K

The investigations made by the launch teams during the night of 23 December revealed that the intake clack valve was functioning normally. Nor did examination of the filter lead to discovery of any traces of pollutants or ice (but the latter could have melted before disassembly).. After cleaning with helium to eliminate traces of water in the tubing and the sphere, a series of filling-emptying operations showed that the circuit was now normally.

The specialists are therefore reduced, for the time being, to hypothesizing about the origin of the incident, which could have been caused when the helium circuit was released into the air: at the moment of transition to the synchronized sequence (H - 6 minutes), the helium sphere is raised to flight pressure and the clack valves are closed; but before the umbilical cords of the helium circuit are disconnected--they are under pressure too (200 bars), like the sphere--they are emptied by means of the release-into-air valves positioned on the flexible tubes. A plug of ice (formed by cryopumping) or a plug of gas (formed by a thermodynamic phenomenon analogous to vapor lock) could have been produced at this moment.

The conditions of the incident are presently being simulated on the launch pad in an attempt to repeat the phenomenon and try to explain it. But it has in any case been decided that the opening of the helium-circuit valves to the air will henceforth be done through a helium atmosphere, in order to prevent the incident from occurring again during a launch.

24 December Launch Attempt

Paris AIR & COSMOS in French 12 Jan 80 p 37

[Text] With the third launch attempt, on 24 December, the countdown went normally up to suspension of operations at H-2 minutes 14 seconds by the launcher control bench, which showed a firing interdiction (ELA ["Ariane" Launching Complex] red).

The incident was caused by the absence of a closure report for a clack valve of the fuel circuit at the moment of the stoppage of the fine adjustment of the liquid-hydrogen supply for the third stage. This closure report for clack valve 36 is one of the "key times" beginning at H - 3 minutes, during the synchronized sequence in the course of which the control-bench computers pilot the operations completely and automatically. A threshold time to 5 to 10 seconds is provided (in accordance with the tests on the ground carried out previously) for the closing of this clack valve. But this time, the clack valve closed in 11 seconds, probably as a result of a seizure of the control organs. The closure report therefore did not get to the computers by the time fixed, so that the computers quite normally considered this an anomaly and ordered "return to initial configuration" (RCI) of the launcher, for resumption of the synchronized sequence at H - 6 minutes.

The operators then succeeded in unsticking clack valve 36 by commanding opening and closing of it several times manually, after disconnecting the computer to take manual control of the operations again. The functioning of another clack valve (clack valve 33), which has the same function on the liquid-oxygen line, was also checked.

But this incident, although resolved, caused another one shortly afterward. When the launching-operations chief wanted to go back to automatic computer control to resume the synchronized sequence (mainly to finish filling up the third stage), a new incident occurred. One of the "authorizations" for resumption of the synchronized sequence by the control-bench computers did not function, as the result of a failure of a circuit powering a relay in the device.

The skillfull intervention of three launching-center technicians--Gaston Rabeau, of COMSIP [expansion unknown], Pierre Perez and Gerard Lagrenee, of the CNES--was necessary to save the situation. Being thoroughly acquainted with the circuits concerned, they literally short-circuited a part of the defective circuits by improvising, on the spot, the running connections needed to supply shunted power to the relay authorizing return to automatic configuration, so that the rocket could take off.

Without this decisive intervention, it is highly probable that the launch would have had to be postponed again. It may even have had to be abandoned, for the fuel reserves necessary for another attempt were at a critical threshold.

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FEDERAL REPUBLIC OF GERMANY

NEW AUTOMATION CONTROL SYSTEM OUTLINED

Leinfelden-Echterdingen CHEMIE-ANLAGEN + VERFAHREN in German No 7, 1979 pp 39-41

/Article by Ladislaus Borsi, Horst Hüllemann, Jürgen Oemigk/

/Text/ The increasing requirements for the efficiency and economy of technical processing systems entail an increasing information flow and a more complicated intermeshing of the problems being solved. The instrumentation, both on site and in the maintenance stations, has become correspondingly more extensive. The planning, assembly, start-up, and handling of such systems is personnel-intensive and consequently quite costly. For a long time, the route of process automation appeared characterized by two possibilities: One path was stamped by specifically programmed regulation and control systems, and the other by universally usable process computers. Cost problems on the one hand and a quicker succession of innovations on the other hand, however, require an orientation which facilitates, over the long term, more ready and better adaptation to increasing levels of automation, and which at the same time takes into account the increased requirements for safety on the part of man, machine, and their environment.

Characteristics of the System

The automation system Teleperm ® M is supported by microprocessors and was designed for the most stringent demands as regards function and availability. It was here possible to achieve both a cost saving in planning and documentation as well as increased compatibility for changes in assembly and start-up. Special consideration was also given to the requirement of combining components of the Teleperm M system with those of other systems. The hardware was standardized by means of microelectronics, in order to reduce the number of types. This was supplemented by standardized, transferable system software. It is no longer presupposed that the user has programming expertise.

In developing the Teleperm M system, the starting point on the one hand was the wide experience of industrial electronics and on the other hand was the technology of process computers (Figure 1). The concepts analog, centralized and decentralized, as well as parallel and serial, are to be regarded as non-exclusive and mutually supplementary in this system.

The following technical aspects of the system should be especially emphasized:

- in function, the structure is decentralized, while in spatial arrangement it may be centralized or decentralized,
- both parallel and serial transmission of information, and
- parallel and serial operation and observation.

The decentralized structure of functions close to the process, according to Figure 2, makes possible an organization that is clear and easily controlled, into areas that are related technologically as well as functionally. All automation functions of a system area, such as regulation, control, monitoring, and reporting, are collected together in an autarkic automation system. This "automation island" can be implemented just as easily as various algorithms in the function-bound digital control, on the basis of microprocessors. This structure can be adapted, within broad limits, to various reliability requirements. Additional advantages are obtained with decentralized assembly, e.g. less labor in cabling.

Various factors facilitate optimal technical and economic solutions: parallel transmission paths for acquiring process variables and for outputting positioning instructions, as well as serial transmission paths for the communication of the automation systems among one another, and for communication with powerful operating and observation systems.

The spectrum of parallel operation, aided by conventional control units and serial operation with black-and-white or color display units guarantees a maximum measure of flexibility and convenient communication between man and process. With more stringent requirements for availability, operation and observation can also be designed redundantly.

System Overview

The system consists of a number of subsystems, which are mutually coordinated in the scope of their capability (Figure 3). The collaboration of similar or different subsystems, through standardized hardware and software interfaces, makes possible an extremely flexible and optimal adaptation to the process. Each subsystem is also capable of functioning, without any restriction, by itself alone and without any coupling to the bus.

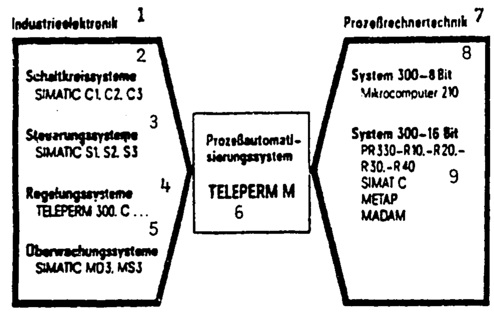


Figure 1: Synthesis of Experience

Key: 1. Industrial electronics; 2. Switching circuit systems; 3. Control systems; 4. Regulation systems; 5. Monitoring systems; 6. Process automation system TELEPERM M; 7. Process computer technology; 8. System 300- 8 Bit microcomputer 210; 9. System 300-16 Bit.

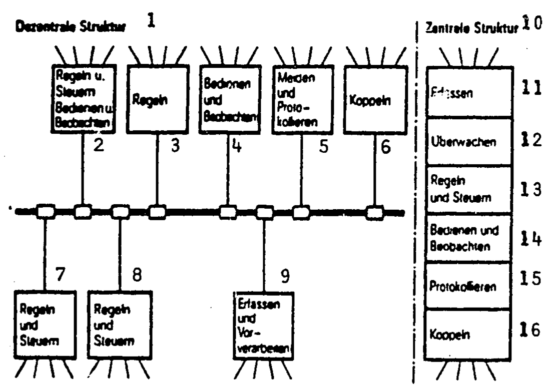
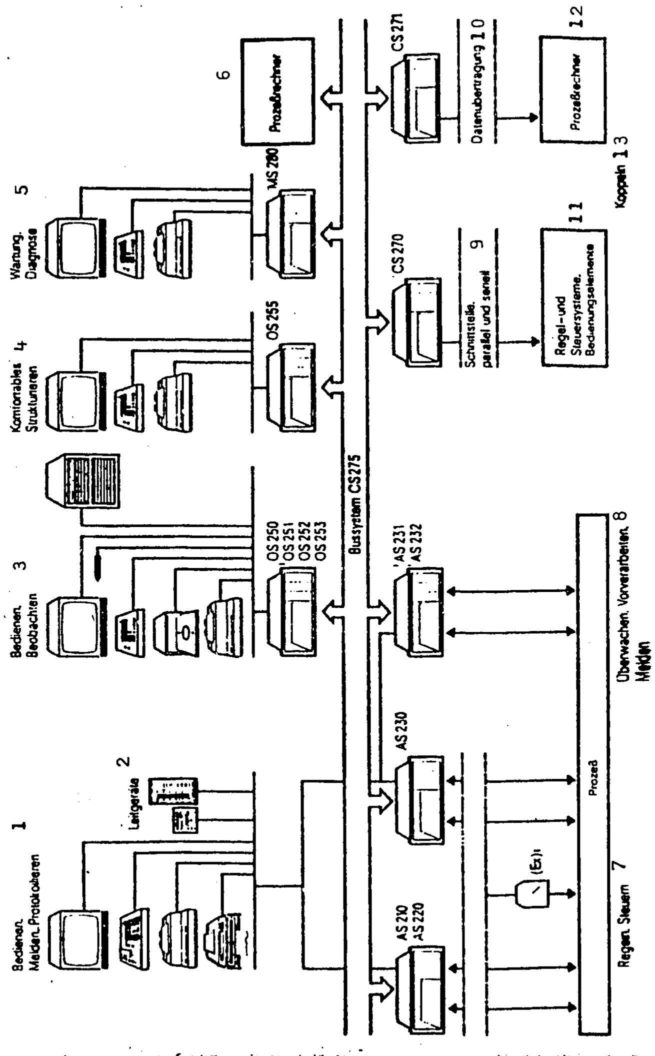


Figure 2: Decentralized and Centralized Structure of Functions in Automation Technology

Key: 1. Decentralized structure; 2. Regulation and control, operation and observation; 3. Regulation; 4. Operation and observation; 5. Reporting and recording; 6. Coupling; 7. Regulation and control; 8. Regulation and control; 9. Acquisition and preprocessing; 10. Central structure; 11. Acquisition; 12. Monitoring; 13. Regulation and control; 14. Operation and observation; 15. Recording; 16. Coupling



[Key on following page]

Figure 3: Teleperm M-System Overview

AS Automation Systems
MS Diagnostic System
OS System for process observation and operation
CS 270, 271 Auxiliary systems
(Ex)i Multiplexer in explosion-protected design

Key: 1. Operation, reporting, recording; 2. Control units; 3. Operation, observation; 4. Convenient structures; 5. Maintenance, diagnostics; 6. Process computer; 7. Regulation, control; 8. Monitoring, preprocessing, reporting; 9. Interface, parallel and serial; 10. Data transmission; 11. Regulation and control systems, operating elements; 12. Process computer; 13. Coupling

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The system contains the following components:

- the automatic systems (automation subsystems) AS 210, 220, 230, 231, for monitoring, regulating, computing, controlling, reporting, and recording,
- the systems OS 250, 251, 252, 253 for observing and operating the process (operating subsystems),
- the bus system (coupling subsystem) CS 275 for data communication between the components of the Teleperm M system,
- the auxiliary system OS 255 for parameterizing and structuring the automation systems with a high degree of convenience,
- the auxiliary systems CS 270 and 271 for coupling of permanently wired automation units and process computers to the system bus, and
- the diagnostic system (maintenance subsystem) MS 280.

Automation Systems

The automation systems AS 210, 220, 230 are graduated in accord with their capability. They are used to solve regulation, control, computation, monitoring, reporting, and recording tasks (Figure 4). The AS 231 system is a pure data processing and reporting system. Within the automation systems, the various functions, e.g. regulation, control, and reporting can be arbitrarily intermixed (1).

In terms of hardware, the automation systems are divided into a basic unit and into one or more expansion units (Figure 5). The subassemblies for the power supply, the central processor, the memory, as well as connections for the operating unit (2), the bus system CS 275, the mini-floppy disk, and the page printer are all housed in the central area of the basic unit. With the exception of the AS 210 system, in which the MC 210 microcomputer is used, all automation systems have microprogrammed processors with 16-bit processing. High-value instructions, e.g. floating point multiplication, are processed with microprograms. Consequently, the processing speed of the processors is very high. The performance data of the automation systems are correspondingly favorable. For example, with the AS 220: a maximum of 120 regulation loops can be processed per second, with a minimum scanning time of 100 ms; processing time for a control instruction is less than 4μs. The input-output (IO) subassemblies are the connecting links of the automation system to the process. Here, the process signals (analog measured values, binary signals) are acquired and are prepared for processing in the central processor. The subassemblies also contain the output function for the positioning instructions

Funktionen 24		AS 210	AS 220	AS 230	AS 231
Spezialbausteine	1				
Melden	2				•
Bedienen	3				•
Überwachen	4				•
Vorverarbeiten	5				•
Sprachmittel	6				
Protokollieren	7			•	•
Rechnen	8			•	•
Steuern	9			•	•
Standardbaustein-erweiterung	10				
Alarmverarbeiten	11			•	
Mehrfachprogramme	12		•	•	•
Standardbausteine	13				
Überwachen	14	•	•	•	
Regeln	15	•	•	•	
Rechnen	16	•	•	•	
Regeln und Steuern	17	•	•	•	
Bedienen	18	•	•	•	
Melden	19	•	•	•	
Anzeigen	20	•	•	•	
Strukturbedienung	21				
Eigenstrukturieren	22	•	•	•	•

→ Leistungsfähigkeit, ausbaubar 23

Figure 4: Performance Areas of the Automation Systems AS 210, 220, 230, and 231

Key: 1. Special components; 2. Reporting; 3. Operating; 4. Monitoring; 5. Preprocessing; 6. Language means; 7. Recording; 8. Computing; 9. Controlling; 10. Standard component expansion; 11. Alarm processing; 12. Multiple programs; 13. Standard components; 14. Monitoring; 15. Regulating; 16. Computing; 17. Regulating and Controlling; 18. Operating; 19. Reporting; 20. Indicating; 21. Structural conditions; 22. Self-structure; 23. Capability expandable; 24. Functions

furnished by the central processor. The IO capacity of the basic unit can be expanded by connecting expansion units, each with a maximum of 14 IO subassemblies (3).

For especially important automation tasks, e.g. for a critical regulation loop, the system offers compact, intelligent IO subassemblies with their own microprocessors. Besides the input-output function, they also contain back-up functions, e.g. autarkic power supplies and back-up regulators. The availability of the automation system can therefore be planned, i.e. can be adapted to the respective technological requirements (4).

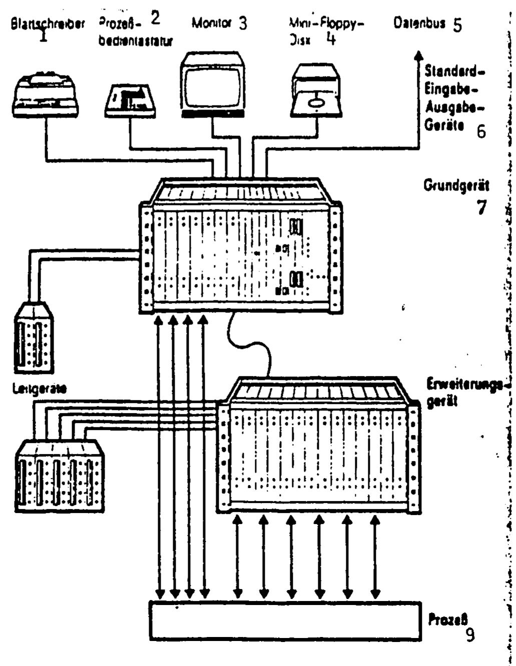

Figure 5: Components of the Automation System AS 220

Key: 1. Page printer; 2. Process operating keyboard; 3. Monitor; 4. Minifloppy disk; 5. Data bus; 6. Standard input-output units; 7. Basic unit; 8. Expansion unit; 9. Process; 10. Control unit

Furthermore, a multiplexer for field attachment can be connected in series with the automation system, in order to acquire and preprocess process quantities in areas where there is a risk of explosion.

The system software of the automation systems is written in a higher language. This guarantees the transferability of the software. In case of a hardware innovation, e.g. when a more powerful processor is inserted, the system software can therefore be adapted to the new hardware with only minimal labor. Hardware innovations can therefore be purposefully used within the system.

The system software does not appear to the user. Most of the automation tasks can be solved with the modular language of the system, using simple technological notation. The read-only memory houses the software modules, which can be parameterized and arbitrarily linked with one another in the conversational mode using the display unit (1). The automation systems AS 230 and 231 contain not only the modular language but also the TML language (Teleperm M language) to formulate high arithmetic functions and to generate freely plannable records.

Systems for Process Operation and Observation

Within the Teleperm M system, means are offered for process operation and observation. These means are adapted to the requirements of the operating personnel (2). System operation for structuring and parameterizing the system is undertaken by specially trained personnel. The components for process operation and observation, within the framework of the Teleperm M system, are graduated in accord with their complexity and power:

- Control units for parallel operation of a single function, e.g. a regulation loop
- Operating units, consisting of a black-and-white display unit and a process operating keyboard for operating an automation system
- Operating systems OS 250, 251, 252, 253 for operating and observing several automation systems through the CS 275 bus system. The OS 250 system contains a black-and-white display unit, and the OS 251, 252, and 253 systems contain at least one color display unit.

This list indicates that the process operation and observation, with the Teleperm M system, is stamped by the use of display screen units. These facilitate better organization, clearer presentation of the information, and consequently they unburden the operator and permit better control of disturbances. The use of display screen units also significantly reduces the space requirement of the console. For reasons of availability and safety, purely serial operation through a display screen unit is not suitable. In those cases, additional control units, operating in parallel, can be utilized. In this way, parallel and serial operating techniques can be combined with this system, so as to be optimally matched to the automation task.

The process operation and observation used here is characterized by an hierarchical organization of information. The operator can select various hierarchical levels, starting from a total overview of the process, which contains only coarse information, right down to a detailed image representation, e.g. of a single regulation loop. Consonant with the idea of "operator guidance", only those activation possibilities are offered to him which are permissible for a selected component process. The probability of misoperation is therefore very low. The representation of the information on the display screen is based on the experience of many years of work in the area of ergonomy, especially in the area of human engineering.

Bus System

The CS 275 bus system is used for serial data transmission between the individual systems of the automation system (6). The bus system offers components that are graduated with respect to their complexity and power as well as in accord with freedom from interference, both in the near region (up to 100 m) and in the remote region (up to 4 km).

By using bus systems in place of the currently traditional selecting mains, the cabling and engineering costs can be significantly reduced. As the availability requirements for data communication become more stringent, the bus of the Teleperm M system can be designed redundantly.

For further information see CAV-216.

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FRANCE

AIMS OF NATIONAL RESEARCH PROGRAM FOR 1980-1990 OUTLINED

Paris LE PROGRES SCIENTIFIQUE in French Sep-Oct 79 pp 3-9

[Article: "The 10-Year Research Program: A New Strategy for National Scientific Policy"]

[Text] The national research policy carried on by the government in recent years has proceeded from the made at the two limited Cabinet meetings chaired by the president of the republic in February and November 1975.

Thanks to the application of these decisions, it has been possible to preserve, overall, the budgetary contribution of the state to scientific and technical research despite a difficult economic and financial situation; the rate of recruitment of young researchers has been maintained at a suitable level; certain research sectors or themes (for example, energy and biomedical research) have been given a distinctly higher priority; and finally, the structures of certain large public research organisms (CNES [National Center for Space Studies], CNEXO [National Center for Exploitation of the Oceans], and now INRA [National Institute of Agronomic Research]) have been reorganized in such a way as to get better value from the results of their research.

But during these same years, the world economic situation has changed profoundly. It is causing France to reconsider what means can contribute to its prosperity and its independence in foreign markets. Thus, if the national scientific and technical research potential is to remain one of the essential instruments for our country's development, it must be placed at the service of new objectives, clearly defined and meeting the present economic and social exigencies.

In addition, the R and D efforts being made by certain of our direct competitors (United States, FRG, Japan) raise acutely the question of the proportion of its gross domestic product that our country should devote to these activities.

Thus it is that on the request of the president of the republic, the secretary of state for research has worked out the broad outlines of an overall strategy, revisable as needed, and leading to the elaboration of a 10-year research program that defines national scientific policy for the coming years.

Why a 10-Year Strategy?

First of all, it should be kept in mind that research has to be organized over a long period. The training of people and the formation of teams that have an international audience--a necessary condition for dialog with world science, of which we represent only 6 to 7 percent--take some 10 years. A time period on this scale is needed also for conceiving, building and putting to use the great instruments of contemporary research.

But a sufficiently long time period is also necessary for integrating research more completely with the development prospects. Opening up research and fitting it more closely into economic and social life are a central objective of the 10-year program. To this end, the orientation of the programs and the organization of research will favor the extension of cooperation between research and the country's socioeconomic activity.

The 10-year program, conceived in this spirit, can proceed only from an approach quite radically different from that of the previous planning periods, which were expressed in terms of more or less detailed programming of the research sectors. The establishment of a true research strategy must definitely be based on:

--drawing a comparison between the principal challenges posed by economic and social development and the dynamic of the sciences and technologies, with a certain number of lines of effort implying a very broad mobilization of our scientific potential;

--proposing a new organization of research centered on quality, openness, cooperation and complementarity between public research and industrial research.

Three Guiding Principles

Such a study rests on three guiding principles: development, breaking down partitions, coordination.

--Development of the proportion of France's gross domestic product devoted to the R and D effort (presently 1.8 percent), so as to get our country, in the medium term, to the level reached by the comparable industrial countries (FRG, Japan).

--Breaking Down Partitions: A general feature emerges from exploration of the lines of force of the research policy of the next 10 years. The basic sciences are getting more and more into study of complex interactive systems and are thereby bringing the established lines of intradisciplinary communication into question: the most fruitful research will most often bring specialists from different disciplines into association. In the same way, the problems of the economy and society are projecting their own complexity onto the research which takes them as its subjects, leading to the conceiving of new forms of program cooperation.

--Coordination, made more than ever necessary by the very fact of the existence of these horizontal and multidisciplinary research programs. Since 1958, France has provided itself with institutions of coordination which constitute the instruments--still capable of improvement--of such a policy.

Constructed on the basis of these three guiding principles, the broad outlines of a research strategy that defines the priority orientations to be taken into account in the course of the next 10 years, as well as their implications for the plan for organizing and financing research, were submitted by the secretary of state to the prime minister in charge of research to a meeting of the central planning council held on 26 July 1979, under the chairmanship of the president of the republic. They were the subject of a communication by the secretary of state to the Cabinet meeting of 1 August 1979.

The present informational report substantially summarizes the principal analyses made within the framework of preparation of the 10-year program, as well as the decisions that the government has settled on in this matter.

The Orientations of Research

The priorities for research in the coming years (1980-1990) have been identified by a double approach that takes into account both the inherent dynamic of scientific and technical knowledge and their most fruitful applications, as well as the appropriate responses that research is capable of making to the challenges that the French economy and society will have to face.

Priority Sectors for Research

Priority will be assigned to the following orientations:

A. Exploiting the scientific and technological results that have reached maturity, mainly in the following three areas:

--The Technologies of Information and Communication

The progress in microelectronics and the increasing availability of telecommunications networks will have considerable consequences on many activities. Telematics is an example of possible evolution. Data-processing also will have an important impact on new industrial developments. To get all the advantages from it, data-processing research will have to be accompanied by similar efforts in mechanics, materials, pickups, etc, for it is not effective to base data-processing techniques on conventional concepts about materials.

The thinking will also be on the consequences of data-processing innovations on the content of work, and on the conditions for social integration of them.

--The Space Technologies and Their Applications

The advent of space-age techniques on the economic level is the concrete expression of 20 years of research efforts. The prospects for application relate mainly to transmission of information (telecommunications, television) --the growth of which is far more rapid than was imagined some 10 years ago --observation to survey the earth's resources, and exploration of the universe.

The 10-year objectives should be to keep us in a good position on the scientific level and to pursue our effort at market penetration for applications in the face of U.S. competition, and European solidarity is more than ever necessary for this purpose.

--Microbiology and Its Applications

The rapid development of knowledge in basic biology, through exploitation of the concepts and technologies of molecular biology, will obviously bring numerous applications which will be able to come through the moving forces of applied research--medicine, agriculture, aquaculture--but can also be transferred directly to biotechnology. The potentials for application of basic and applied microbiology to the fields of energy, medicine and agriculture appear to be of extreme importance for the future.

B. Intensification of the research effort in the areas destined to have an important impact on the economy and society; in particular:

--Energy

Intensification of research on energy will remain necessary during the coming years. The principal activities will be:

--in the short and medium terms, on nuclear energy, and especially on the fast reactors, on rational utilization of energy, for which research must, starting now, prepare new technical solutions, as well as on the use of solare energy in housing and the exploitation of biomasses for energy. Furthermore, it is important to preserve the technological lead of our petroleum industry and to develop programs on the utilization and conversion of coal;

--in the longer term, active research should be continued on conversion of solar energy and on thermonuclear fusion, which is a long-term labor but one whose importance justifies effective support from now on.

--Genetics, Biological Engineering, and Their Applications

Important progress in technology for the living will be indispensable. In this regard, the medications, agronutritional, medical-instrumentation, agricultural and scientific industries and knowledge of new biomaterials must receive special stimulus during the 10 years to come.

But it is clear that there is increasingly great interest in the achievement of a biotechnology for the living on the basis of progress in basic biology --selective genetics in particular, but also analysis and synthesis of genes, cellular fusions. Thus a biological engineering is being developed whose applications in the fields of energy production from biomasses, elaboration of vaccinal antigens and therapeutic serums, fabrication of fixed enzymes, and improvement of the biological fixing of nitrogen are now being analyzed.

Many other applications are envisioned in agriculture and in industry. Nevertheless, it should be clear that while certain successes have already been achieved in the field of "genetic engineering" in particular, the basic knowledged needed for many applications is still limited.

C. Development of interdisciplinary and intersectorial cooperation, especially in the following two fields:

--Materials

In the physics of condensed matter, basic research on materials (new materials, but also better elaborations, understanding and utilization of known materials), with chemists, physicists and mechanical engineers working in association, will have to be strongly developed so that the industrial problems can be tackled.

--Utilization of the Methods and Instruments of Physics in Different Disciplines (Chemistry, Biology, Medicine, etc)

D. Study of complex interactive systems--mainly:

--Study of the Atmospheric System

The sciences of the atmosphere, making use of very powerful computer equipment and space tecniques, are in a good position to provide new understanding of meteorological and climatic phenomena, the impact of which can be considerable, from the local level (microclimates) to the geopolitical level.

--Study of the Oceanographic Milieu

Oceanographic research has been going on for some 10 years. While the long-term objective is rational exploitation of the resources (mainly the living resources) of the sea, the problem is still essentially a scientific one:

understanding physical, chemical and biological processes which are complex and extended in time. The research, though often of good quality, is still too scattered, whereas cooperation and coordination are indispensable, and there are gaps in certain essential disciplines (dynamic oceanography, chemical oceanography, marine microbiology).

--Study of Biology-Society Interactions

The new orientations of medical research will throw the spotlight on problems such as human nutrition, mental health, the biology of human development and agin, man in his environment, the biology and pathology of the schoolchild, the worker and the athlete, the orientation of "leisure activities," the economics of health, and research on evaluation of medical methods.

--Study of the Interactions between Management Techniques and the Evolution of Life-Styles

The management of our living space has so far been essentially the result of sectorial policies: city planning, construction, transportation policy, industrial policy. New programs should be designed, integrating the technical aspects and the societal aspects. This overall approach is indispensable for establishing a working relationship between the management of space and the evolution of life-styles.

Implementation of the Priority Orientations

The reaching of certain priority goals will take the form of large programs bringing several public or private organisms into association.

Such programs will be implemented especially in the following eight fields:

--alimentation - nutrition;
--medications;
--biotechnologies (based on microbiology and on genetics);
--microelectronics and its applications;
--meteorological and climatic research;
--production of fluid fuels (extraction or conversion techniques);
--mechanics and materials;
--technology and evolution of labor.

Programming of Large-Scale Equipment Projects

Modern research is making more and more use of heavy equipment on a national or international scale (ECNR [European Council for Nuclear Research], GANIL [National Large Heavy-Ion Accelerator], ILL [Laue-Langevin Institue], LURE [Laboratory for Utilization of Electromagnetic Radiation], JET [Joint European Torus], etc).

Planning of these equipment projects over a 10-year period is all the more necessary in that the times required for the design, construction and preparation of the experiments are very long, their unit cost implies hard choices, and their scope becomes very largely multisectorial.

In the studies for proposals for these large-scale equipment projects, special attention will be given to achieving international, and mainly European, cooperation.

Preparation of a "White Paper"

The government assigns the highest importance to the scientific community's being closely associated in defining the 10-year strategy that is to serve as the framework for national research policy.

Consequently, the Academy of Sciences as well as the country's big scientific institutions will participate closely in the work of a committee composed of several eminent scientists and assigned the task of writing a "white paper" on the contribution of scientific research to the progress of France (1980-1990), the preparation of which has been entrusted to the secretary of state for research.

This "white paper," which will be published before the end of June 1980, could not be conceived as an exhaustive catalog of scientific themes or as a definitively fixed research program. It will rather constitute a contribution, revisable as necessary, to definition of a research strategy, in a 10-year perspective.

Organization of Research

For implementation of the orientations defined above, scientific and technical research will be organized according to the following principles:

Interministerial Research Evaluation and Proposal Missions

Under the authority of the secretary of state for research, the General Delegation for Scientific and Technical Research (DGRST), which is to remain a lightweight, flexible and imaginative structure, will carry out fully its functions in interministerial activation, coordination and proposals.

It is assigned the following tasks in particular:

--bringing together the elements of a long-term scientific and technical perspective, based on the broadest international vision;

--maintaining an up-to-date account of the state of French science and technology; this has already resulted in publication of a first summary report, at the end of June 1979[1];

1. Cf LE PROGRES SCIENTIFIQUE, No 199-200, March-June 1979, pp 3-43.

--proposing to the government, especially in connection with preparation of the 5-year plans and the annual budgets, the decision to be made for the broad balances of research policy, as well as the principal programs which the state should favor.

In accomplishing this mission, the DGRST will carry out the broadest consultations and will see that the country's big scientific institutions (Academy of Sciences, Advisory Committee on Scientific and Technical Research, National Committee of the CNRS [National Center for Scientific Research]) are brought into close association.

Strengthening the Action of the Scientific Advisors and Attaches Abroad

France has a large network of scientific advisors and attaches posted to the embassies of France abroad. In addition to their traditional role of representing scientific circles abroad, information, and organizations of missions, they must carry out more activity aimed at external eexploitation of the value of French research, in liaison with the commercial advisors under the authority of the minister of foreign trade, and upstream from them.

Before the end of 1979, a report on the conditions of appointment, reappointment and training of these scientific advisors will be made to the prime minister.

Cooperation with the Developing Countries

The minister of foreign affairs, the minister of cooperation and the secretary of state for research are studying the ways to improve the procedures for negotiating cooperation programs with the developing countries.

This study will be sent to the prime minister before the end of 1979.

Financing Research

Growth of the Proportion of GNP Devoted to Research-Development

For some 10 years, the private firms have in effect kept up their R and D effort as a proportion of GNP. The overall reduction in the intensity of the national research effort (ratio between domestic reasearch expenditure and GNP), which dropped form 2.2 percent to 1.8 percent, is attributable to public financing.

Consequently, it has been decided that public research credits will grow in the coming years will grow at such a rate that the proportion of France's GNP devoted to research will gradually come up to the rate achieved in those industrialized countries that are of comparable size and are most active in research (Japan, the FRG, where is is close to 2.2 percent).

As regards the private firms' research efforts, which is still insufficient in all the traditional sectors of activity, the ministry of industry and the secretary of state for research will examine, before th end of the year, the ways and means for achieving a further increase in this research effort in the medium term, and will transmit their proposals in this regard to the prime minister.

Management of Public Research Credits

The distribution of public research will be based on two distinct types of financing:

--on the one hand, basic institutional financing aimed at promoting a scientific and technical potential of high quality;

--on the other hand, the financing of purpose-directed programs bringing various public and private laboratories into association on projects that conform to the priority orientations of research. This financing will take into account the capacity of the laboratories concerned to propose and carry out such programs, and the research organisms will be asked to work out program budgets.

The research groups thus set up will have a temporary existence, coextensive with the period for carrying out the programs undertaken. Several types of group can be envisioned: the "scientific interest groups" (GIS), in which each partner retains its own specialty, will be encouraged. The secreatry of state for research will shortly present to the government some specific proposals in this regard.

On the financial level, the big interorganism programs will be individualized. Credits will be earmarked for them by the participating organisms. They will be supplemented by credits assigned to the DGRST from an interministerial reserve fund. Furthermore, it is indispensable for each of these big programs to have its own unit for scientific management and evaluation.

Within the framework of the reforms presently being undertaken by the minister for universities, mainly in connection with the "rehabilitation" of graduate-level training, revision of the procedures for financing research is necessary. The Research Mission, assigned the task of activating and coordinating the research policy of the establishments that come under this department, will see to it that a sizable proportion of its credits goes to those of them that are destined to become important poles of research.

Finally, the allocation of state aid to research and innovation will take into consideration the industrial firms that will receive funds in research groups in association with public laboratories, and that will also practice a recruitment policy which takes in a large number of personnel from the public research organisms.

Scientific Employment

The central planning council has adopted the proposals presented to it by the secretary of state for research relating to the status of the researchers of the public organisms.

The main orientations of the reforms envisioned, which result from the report on scientific employment sent to the prime minister by Michel Massenet, councillor of state, are the following:

--restoring and benefiting from the notion of a probationary period upon entry into the research organisms by lowering the minimum age for entry into the organisms to 27 (with various exceptions) and limiting the duration of this probationary period to 4 years;

--overhauling the recruitment procedure in the direction of greater clarity and greater selectivity. In this regard, it is planned to dissociate judgment of the applicant from judgment about the laboratory. The probationary period would be done in a laboratory designated as a "training" laboratory," and the researcher would then be assigned, subject to some special exceptions, to another laboratory called a "recruiting" laboratory;

--modification of the rules relating to promotion of researchers with a view to favoring their mobility and their availability;

--creation or restoration of procedures aimed at breaking down the partitioning of researchers' careers: for example, restoration of the procedure for reciprocal assignments, development of reception positions and of possibilities for mobility toward the private-firms sector.

During last July, the secretary of state for research informed the major trade-union organizations of the orientations adopted in this area.

The managements of the organisms concerned are consulting these organizations about the modalities for application of the reforms envisioned.

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FRANCE

FIRST OPERATIONAL FRENCH LASER GYROSCOPE FLIGHT-TESTED

Paris AIR & COSMOS in French 5 Jan 80 pp 25-28

[Article by Gerard Collin]

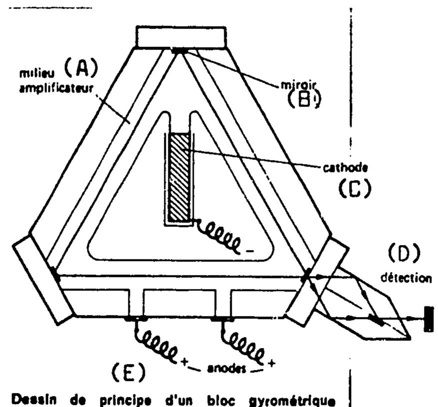
[Text] The Laser Gyroscope

We shall briefly review here the principle of the laser gyroscope. A laser emits two successive waves circulating in opposite directions in a tuned cavity (triangular in this case). When the assembly rotates, the paths followed by the two beams are different, inducing a difference between the two frequencies and therefore a beat between the two beams, whose frequency is directly proportional to the angular rate of rotation of the assembly.

The advantages of such a gyroscope are well-known: high reliability (no mechanical moving parts), insensitivity to acceleration, almost instantaneous starts, digital output, and high performance up to 400 °/s, the limit generally accepted for combat plane flights. However, the laser gyroscope is of very delicate construction, especially with respect to its mirrors (essentially 100% reflection) and to the dimensional stability of the optical paths (tuning of the resonating cavity). In addition, the two laser beams become synchronized at some points of the cavity, creating a zone insensitive to small rotation rates, known as the blind zone. The solution adopted by SV2 is to mechanically vibrate the gyroscope, eliminating the low instantaneous velocities and therefore the blind zone, and linearizing the output.

For the principle of the laser gyroscope and a history of the concept's development by Sfena and then SV2, see AIR & COSMOS No 706, 18 February 1978, pages 22 and 23.

The inertial unit Sextan of SV2 was flight-tested for the first time at the Flight Testing Center (CEV) of Bretigny, on a Puma helicopter, the day after Christmas, 26 December of last year.



Block diagram of a laser gyroscope.

Key: (A) Amplifying medium
(B) Mirror
(C) Cathode
(D) Detection
(E) Anodes

We believe this to be the first time anywhere that flight tests have been announced for a laser gyroscope unit mounted on a helicopter. Litton is known to be developing an inertial unit of strap-down components for the Hughes AAH armed helicopter, but this unit uses conventional spinning gyroscopes. We also know that Honeywell has developed a laser gyroscope inertial unit with strap-down components, but for the time being appears to have limited its goals to transport planes of the next generation and to military planes (AV8B in particular).

This is the first time in Europe that a laser gyroscope inertial unit has been flight-tested. SV2 thus closely follows Honeywell, and appears to be at the level of the other American companies, Litton among them, which are involved in this difficult project.

This is also the first time in France that a strap-down unit has been flown. SV2 has thus outdistanced the two other companies involved in this area, Sagem and Sfim, whose systems should also be flight-tested very soon.

Program Respected

The first notable aspect of the Sextan flight test is the discipline of the project. We have already stated here that "this unit (integrated today into Sextan) will be flight-tested in 1980" (AIR & COSMOS No 706, 18 February 1978, p 23), and "SV2 announced today for the second half of 1979, the flight test at CEV Bretigny of the Sextan system on a Puma helicopter"

(AIR & COSMOS, No 766, 9 May 1979, p 35). The project has thus proceeded remarkably close to schedule, and any discrepancies noted were due to being ahead of schedule! We must remember that the "gyrolaser" project was started in 1972 by Sfena, in association with Quantel, which specializes in advanced-design laser technology.

Since then, Sfena has assumed an increasingly greater control of Quantel until it is now the majority voice.

SV2 was created at the beginning of 1978, and the development of gyroscope units became its largest project, at the same time as it brought the collaboration of Crouzet. This synergetic contribution, an operation which is always delicate, did not slow down the program in this case. On the contrary, Sextan appears to have been the occasion for remarkable mutual enhancement of Sfena's and Crouzet's areas of competence. In production, Sextan represents a perfect balance between Chatellerault (Sfena) and Valence (Crouzet). The technical expertise of Sextan is strongly expressed in the laser gyroscopes and is therefore derived from Sfena, while Crouzet contributes the in-house expertise of tactical navigation systems on helicopters, beginning with the Nadir system already adopted by the army (ALAT) for the Gazelle and Puma helicopters. Crouzet also contributed its special strength in pressure and temperature detectors, and in the Cosac compensated three-axis magnetometer. In this way SV2 is fully capable of supplying a complete navigation and altitude system -- except for Doppler -- for future armed helicopters, first among which SV2 of course places the future French-German PAH2, for which an agreement has already been signed between the two countries.

From Study to Production

The first Sextan flight tests denote another important milestone, the entry into industrial production. SV2 is very confident: the era of technologic discoveries will give way to greater emphasis on production and ancillary means. Sfena expects to solve the technical problems of laser gyroscopes, and in particular of mirror quality, and to readily control tuning of cavities.

This mastery is measured in terms of reliability and accuracy. A stability of one degree per hour has already been achieved and even definitely surpassed, according to Messrs. Pagnard and Vasuth.

Another characteristic of the system is that a gyroscope can be replaced through a simple exchange, and naturally without any recalibration. This operation has already been performed at CEV Bretigny in a particularly significant operational demonstration.

However, Sfena and SV2 do not intend to remain at this level of technology, and they propose to explore two areas of development.

First, the development of a more precise gyroscope, with a drift of one hundredth of a degree per hour. This instrument would place SV2's inertial unit at the precision level of one nautical mile per hour, which is the level of inertial navigation units in present transport planes. This unit will meet the Arinc 704 specifications adapted primarily to such new transport planes as the A310 and B767. In fact, Sfena presented this Arinc 704 unit to the European airlines meeting in Toulouse last November.

For this unit, Sfena is developing an accelerometer called Mical, with flexible suspension and capacitive detection. In all probability, this unit will use 16-bit microprocessors.

In addition to a navigation precision of one nautical mile per hour, SV2 expects this unit to have the following characteristics: MTBF of 5000 hours, purchase price 30-40 percent lower than that of a present Arinc 561 unit, and maintenance cost reductions of at least a factor of two.

The flight tests of an Arinc 704 unit are announced by SV2 for the first half of 1982, on a Caravelle. These tests should be followed by similar tests of an inertial navigation unit for military planes during the second half of the same year, with a format probably derived from the US Air Force standard of a three-quarters short ATR (called "F3").

When used in a combat plane, this unit provides two big advantages: rapid alignment, and ability to adapt to very fast attitude changes (nominally up to 400 degrees per second).

Thus, a gyroscope drift of one hundredth of a degree per hour now also seems quite possible for SV2, another very encouraging sign.

SV2 will next undertake a study of square gyroscopes, because for equal perimeters a square optical path offers greater sensitivity and takes less space than an equilateral triangle. The drawback of a square gyroscope is the need for a fourth mirror, with a potential increase in losses beyond the detuning threshold of the oscillating cavity. But even in this case, SV2 has great confidence in the manufacturing technology of these mirrors, so that the fourth mirror is no longer an impediment to development.

Sextan

Sextan is an attitude and navigation system for planes or helicopters, which responds primarily to the operational constraints of armed helicopter flights, therefore including fire control.

Sextan is composed of the various elements reviewed below:

The inertial measurement unit. This unit includes three laser gyroscopes with equilateral triangle optical paths of 21 centimeters. These are helium-neon lasers with a 0.63 micron wavelength, whose cathodes are integral with the optical block. The unit also includes three accelerometers, which are produced by Sfena as well. The numerical computer uses 16-bit microprocessors for a program of six 16-bit Kwords.

The format of the inertial unit is only one-half short ATR; this is a remarkably compact size, when compared to Arinc 704 (navigation unit) which is one and one-quarter short ATR, Arinc 705 (attitude unit) which is one short ATR, and the US Air Force military standard, which is three-quarters short ATR. Another notable feature of the SV2 inertial unit is its low consumption of only 70 watts.

The Cosac static self-compensating compass, by Crouzet. This is a static three-axis magnetometer probe, which also could be considered to be a strap-down type. Together with its electronics, the probe assures a magnetic heading with automatic compensation of the magnetic disturbances introduced by the aircraft. In addition to providing a magnetic heading, Cosac also gives an orientation reference for aligning the inertial unit, along with local magnetic variation data which can be introduced by means of the Nadir computer, for instance (see below).

The unit for static and dynamic pressure, and for temperature measurements. This includes two pressure sensors and a measurement circuit connected to a temperature probe.

The Doppler radar. This is the RDN 80 of Electronique Marcel Dassault, produced under Decca license (England). The RDN 80 provides ground speed, drift, and vertical speed information. It has already been adopted by ALAT for its Puma and Gazelle helicopters, together with the Crouzet Nadir computer (see AIR & COSMOS, No 742, p 31). The performance of the Doppler does not place great constraints on Sextan: the short-term stability of the inertial unit tolerates momentary interruptions in the Doppler transmission.

The Nadir by Crouzet. This unit is a computer frame which combines a display and control panel with a numerical computer. The latter receives all the data: inertial, Doppler, pressure and temperature probes, Cosac magnetometer, as well as manual entries from the keyboard. Nadir performs additional filtering to optimize the calculation of current positions. The filtering makes it possible to make best use of the qualities of each sensor, by combining their short- and long-term stabilities.

Nadir deduces the present position and performs navigation calculations for a flight plan supplied through Nadir's keyboard, for instance. If needed, it can also supply flight instructions to an automatic pilot.

And finally, Nadir acts as a control and alignment frame for the inertial unit.

A comment is in order at this point: thanks to Nadir, Sextan relies on a considerable amount of operational information used on the Puma and Gazelle helicopters of ALAT. This should facilitate the integration of the inertial unit, which in turn should considerably increase the value of the system in armed helicopter applications. The laser gyroscope inertial unit has in fact two definite advantages to begin with:

Rapid alignment: one minute, since the gyroscope requires neither warm-up nor spin-up procedures, as in the case of conventional gyroscopes. It is easy to see that such rapid alignment, and therefore rapid reaction, are essential for military applications (a conventional inertial unit requires several minutes for alignment at best);

Attitude reference precision of the order of several minutes of arc. In this application, the quality of this information is directly adapted to fire control, including optical or infrared optical means for sighting, location, and aiming. The intrinsically excellent quality of attitude reference of platform units is known to be significantly impaired by attitude dips (synchros, and so on) until it typically reaches a quarter of a degree.

CEV's Role

One cannot overlook the crucial role played by CEV Bretigny in the development of Sextan. This participation is measured first of all by the flight tests which have already started, using CEV's Navigation Puma, specially instrumented for such flight tests. It is equipped in particular with a Litton inertial unit which can be used as navigation reference in flight; and it also carries an acquisition and recording system designed by CEV several years ago, and known as BOA (Optimal Acquisition Plug-In). In this case, BOA allows the acquisition and recording on magnetic tape, of the system data at several levels: at detectors, at the program algorithms, at the output of the various assemblies, and for the system as a whole. BOA uses a Sfena UMP computer, and has been primarily assembled by Sfena and Sintra.

BOA makes it possible to replay a flight test several times on installations available at Crouzet in Valence. An image program thus allows a reconstitution of the flight and very flexible modifications of the equipment and programs.

CEV's participation in the Sextan tests will also provide SV2 with considerable operational expertise in the use of the system. CEV in fact is already quite familiar with Nadir.

Another organization which has extensively participated in the development of Sextan is LRBA of Vernon. This group brings its recognized expertise on inertial components and systems. It will also proceed with SV2 laser gyroscope systems very soon, beginning with a unit designed for missile applications.

Also very noteworthy are the very large installations at Crouzet in Valence. Crouzet performs dynamic tests on a Goerz table controlled by a computer; it then integrates the unit within Sextan, particularly for Nadir. And finally, it studies and analyzes the data as we have already indicated.

The official support for Sextan's development has been provided by DRET (primarily laser gyroscopes), DTEN (inertial measurement unit and accelerometer), and STAe (Sextan application). The latter tends to play an increasingly large role, probably because of the PAH 2 program for a French-German anti-tank helicopter.

CEV Test Program

Sextan was received on 27 and 28 November of last year, with delivery to CEV at the beginning of December. All the arrangements were made at Bretigny for the flight tests, which took place on 26 December despite last minute difficulties.

The first test stage will make it possible to validate the Sextan concept. This phase will last about six months with participation from SV2 and CEV.

The second phase will be devoted to evaluation tests as such, beginning in the middle of 1980. This stage will naturally be the direct responsibility of CEV.

1980, A Busy Year for SV2

As we have already stated, the beginning of flight-testing has all the earmarks of a significant step for SV2; it certainly imparts psychological confidence and outwardly lends the increased credibility which will probably expand SV2's contacts.

In the civilian sector, SV2 will continue the development of an Arinc 704 inertial navigation unit, which will thus match Honeywell's. Parallel developments will be carried out for military aircraft. Presentations -- which are considered encouraging for SV2 -- have already been made to Avions Marcel Dassault. In the missile field, 1980 will also see a more extensive development and production of units for missile guidance and stabilization. One such unit will be tested at LRBA with a view to tactical missile applications, and even to some strategic missile programs.

In 1980, SV2 will begin pre-production of several Sextan systems.

The means of production for gyroscopes, accelerometers, and systems are being installed at Chatellerault in an expansion of the Sfena plant. The current gyroscope production capability of one gyroscope per month, will gradually be increased to two and then four per month, to reach 30 and even 100 gyroscopes per month, including all aerospace and marine applications. But one point has already been made by SV2: the flight of a laser gyroscope inertial system as part of a specific application objective, a technologic first for Europe.

Operation Specification of Sextan

Longitudinal speed	-50 to +350 km/h (-30 to +190 knots)
Lateral speed	-50 to + 50 km/h (-30 to + 30 knots)
Vertical speed	-2500 to +2500 ft/min
Roll	± 65°
Longitudinal trim	∓ 25°
X Y load factor	± 0.3 g
Z load factor	0 to 2 g
Angular speed	± 50°/s

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