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FRG Government Outlines Space Policy in Bundestag Statement

3698m150 Bonn REPORT OF THE FEDERAL GERMAN PARLIAMENT, 11th Legislature, in German No 11/797, 15 Sep 87 pp 1-15

[Response by Dr Probst, parliamentary secretary of state in the Federal Ministry for Research and Technology [BMFT], on behalf of the FRG Government on 15 September 1987 to the multiple parliamentary questions from Deputy Wetzel and the Green parliamentary group: "Civil and Military Objectives of FRG Aerospace Policy"]

[Excerpts]

I. Consequences of the Challenger Disaster for the FRG Government

[Question—1] When and how is the FRG Government thinking of revising its assessment presented to the FRG Bundestag and the public on 19 February 1986: "According to today's estimates, the German space program and the ESA [European Space Agency] program are not substantially affected by the Challenger accident. We shall therefore continue making adjustments," in view of the fact that more than half the scheduled space projects named on 19 February 1986 have not only been partially postponed to a considerable extent, but several projects (compare below) are threatened with complete cancellation?

Dr Probst: The evaluation of the Challenger disaster's consequences for the German space program and the ESA program was made on 19 February 1986 based on the information available 3 weeks after the Challenger disaster. Today, after the accident report and the recommendations of the U.S. commission established to inquire into possible causes of the accident have been published and considering the date when shuttle launches will be restarted in July 1988, a more precise estimate is possible of the effects on projects, as given below. As a result, nothing fundamental stands in the way of FRG Government aerospace policy.

[Question—2] Considering that serious observers believe that our current level of technology obliges us to expect a fatal accident once every 20 to 30 space flights, what conclusions does the FRG Government draw from the Challenger disaster about the reliability of manned space flights?

Dr Probst: No surveys have been presented to the FRG Governmentsupporting the assertion that the current level of technology obliges us to expect fatal accidents every 20 or 30 space flights. Accidents cannot be completely excluded either in earth-bound or in space-related technological processes. All processes for further technology development aim, however, at further reducing the risk of accident and minimizing the effects of any possible accident. Therefore, future space flight projects will take rescue installations for the crew into account.

[Question—3] What timetable does the FRG Government expect to follow, especially for the 13 projects named to the FRG Bundestag Research and Technology Committee on 19 February 1986 (declarations for the individual projects in accordance with the sample in the deposition dated 19 February 1986)?

Dr Probst: New timetable:

1. Ulysses: ESA-NASA polar solar probe (ISPM), launch planned for 15 May 1986 with Challenger mission 61-F. Postponed to October/November 1990.

2. Galileo: US-FRG Jupiter probe, launch planned for 21 May 1986 with Atlantis mission 61-G. New launch date planned November 1989.

3. Space telescope (Hubble): NASA-ESA project, launch planned for 10/86 with Atlantis mission 61-J. Postponed to the end of 1988.

4. RMK on EOM-1/2: EOM program newly drawn up by NASA. New name: Atlas (only platform missions). Atlas-1 corresponds approximately to EOM-1/2, launch in 1991, NASA offer for RMK flight participation still in force.

5. IML-1: NASA mission with ESA participation (D-1-Biorack). Launch planned for mid-1987, now postponed to mid-1990

6. Rosat: FRG/UK/U.S. program for an X-ray satellite. Launch planned for September 1987. Postponed to the end of 1989 or early 1990. Now with Delta II launch vehicle instead of the Shuttle.

7. GRO: NASA project "Gamma Ray Observatory" with FRG participation: two telescopes. Launch planned for fall 1988. Postponed to January 1990.

8. Microwave Atmospheric Sounder (MAS) on EOM 4/5/6: first MAS flight on Atlas-1 in fall 1991. Further MAS flights on Atlas 2 and 3 are currently being discussed by the BMFT and NASA. No flight timetable has yet been definitely established.

9. D-2: FRG spacelab mission, launch originally planned for fall 1988. Now 1990-91.

10. SIR C/X-SAR: First X-SAR flight together with NASA's SIR-C in the Shuttle radarlab 1 (SRL-1), mid-1991. Further flight planned 6 to 18 months later on SRL-2.

11. MAUS/GAS: FRG flight participation container (GAS) with experiments in conditions of microgravity, two flight possibilities per year. Launches can only be planned after Shuttle flights have started up again.

12. Columbus: No direct effect.

13. Hermes: No direct effect.

[Question—4] What additional consequences for the FRG and the ESA does the new timetable published by NASA on 2 October 1986 have, according to which only 15 of the originally planned payloads will be launched into space?

Dr Probst: The new preliminary timetable published by NASA on 2 October 1986 takes the U.S. President's directive to NASA into account, to withdraw from launching commercial satellites using the Shuttle. This substantially eliminates launches of commercial communications satellites. The FRG and the ESA had not planned such launches with the Shuttle.

[Question—5] If the FRG Government supports the D2 mission originally planned for 1988, what possible changes does it foresee and how does it react to the estimates that the D-2 mission will hardly be able to be started before 1992?

Dr Probst: By supporting the completion of the D-2 mission, the FRG aims more than ever at using the spacelab's facilities independently and at the same time to develop an application oriented space station under German leadership.

The launching date for the D-2 mission was planned for September 1988 after completion of the D-1 mission. According to current NASA plans, the D-2 mission should be started in the third quarter of 1991. Furthermore, the BMFT and the DFVLR [German Research & Experimental Institute for Aeronautics and Astronautics] project leadership will attempt to apply all possible pressure on NASA to achieve a launch date for the end of 1990.

About one-third of the capacity available on the D-2 mission for German experiments was reserved exclusively for industrial users. However, more experiment proposals were received from home and abroad than could be fit into this third. After the preliminary selection for the group of industrial experiments had been made, only one experiment was withdrawn because of the launch postponement. This experiment has been replaced by another.

[Question—6] How does the FRG Government evaluate the Rogers Commission inquiry report into the Challenger disaster published in July 1986 and what conclusions does it draw from this report?

Dr Probst: The FRG runs no independent national manned space flights. Therefore, the Rogers Commission report can lead to no direct German conclusions. The necessary conclusions for manned European projects are being drawn at the appropriate ESA level and these conclusions have already lead to changes in safety concepts.

[Question—7] How does the FRG Government consider the opinion of the Greens that expensive experimental aerospace projects can at the most be carried out within an international framework, that is, by creating a United Nations Space Agency or in cooperation between all member states of different blocks committed to space travel?

Dr Probst: The FRG Government assigns considerable significance to international cooperation in peaceful exploitation of space. The government promotes it on a multilateral level, mostly in the ESA framework, and on the basis of bilateral cooperation agreements. In the government's opinion, the organizational and institutional forms of cooperation—also with Third World countries—have so far proved themselves and should not be burdened with additional problems such as the creation of new institutions at UN level; nevertheless, the FRG Government has always taken an active part in the work of the already existing UN space committee.

[Question—8] Is the FRG Government's current position of wanting to strive for autonomy in West European aerospace policy as quickly as possible caused by the Challenger disaster, by NASA's weak points that this revealed and the space projects that failed in the United States later into summer 1986, or are there other decisive factors?

Dr Probst: The FRG Government's position is clarified by its decision dated 16 January 1985, in which it decided to secure and extend what had been achieved in the framework both of the FRG aerospace program and of European and transatlantic cooperation. The FRG Government pointed out in that decision that it considers German aerospace activities to cover a considerable part of its foreign, economic and technology policy, which is of worldwide scientific-technological and economic but also great political significance for the FRG itself, for European independence and for transatlantic cooperation.

II. Conceptual Reflections and Stipulations of FRG Aerospace Policy

[Question—9] Why has the FRG Government so far failed to present its "Space Travel 2000" program, originally announced for October 1986, to the FRG Bundestag and the public (see FRANKFURTER RUNDSCHAU, 31 October 1985)?

Dr Probst: The FRG Government is preparing a project with long-term perspectives for the FRG space program, in view of its as yet incomplete participation in the European long-term space plan, which was only presented by the ESA managing director in June 1987. The careful development of that program must take numerous economic, technological, financial, security policy, scientific, and general social aspects into consideration.

Once it has been approved, the FRG Government will present the program] to the parliament and the public.

[Question-10] What surveys has the FRG Government so far undertaken for the objective announced in the fourth space program of 1983 to "accelerate conversion of scientific knowledge into economic products" and what results have these investigations had?

Dr Probst: The FRG Government has contracted out several studies that have registered the conversion of scientific knowledge into economic products. Economically beneficial products have arisen from subsidized technological developments in the fields of communications technology with satellites and evaluating earth reconnaissance data. The firm Intospace was founded by various economic enterprises on 22 October 1985 as a result of studies in the field of material research in microgravity conditions.

[Question—11] What investigations and assessments of costs and benefits has the FRG Government so far undertaken in order to reach the objective reported in the fourth space program "to ensure tomorrow's employment levels by funding highly developed aerospace technology considered as the technology enhancing future innovations" and what are the results achieved with these surveys?

Dr Probst: The FRG Government subsidizes space flights and space exploration because it is convinced that these are important technological fields which will be decisive to maintain competitiveness in the future. A precondition for space flights pacemaking role is a broadly distributed technology transfer into other research and industrial fields. An analysis of the period 1976 to 1985 has proved that around 40 percent of government subsidies for aerospace for participating companies is passed onto scientific institutions and enterprises in other sectors; this will enable to disseminate new knowledge considerably. Other surveys are being prepared.

Aerospace and space exploration are such long term projects that today a monetary evaluation of future profits is not yet possible. Formalized cost-benefit analyses according to Art. 7 section 2 of BHO [Federal Budget Standing Orders] are therefore impossible.

[Question-12] What is the number and structure of jobs developed since 1962 in those industrial branches that have participated directly or indirectly in space policy projects?

Dr Probst: The number of specifically space oriented jobs is not registered officially, but industry has been giving information about the employment situation in combined air and space industries of its own free will since 1973. According to this, the number of employees involved in space travel has risen from 2,783 in 1973 to 5,758 in 1986.

The job structure is determined substantially by system firms, telecommunications companies and other equipment firms as suppliers. Space industry is characterized by high research and development expenditures. Therefore, most jobs are highly qualified (for high school and technical school graduates, technicians and skilled workers).

[Question-13] What effects on labor policy does the FRG Government expect from the FRG's participation in advanced large-scale aerospace projects (such as Ariane 5, Hermes or Columbus), and what surveys has the government contracted so far with what results?

Dr Probst: The relevant industrial firms would be responsible for the execution of the three projects Ariane 5, Columbus, and Hermes. They would have to organize themselves in such a way that, in the case of contracts awarded by the ESA, their resulting contractual obligations could be satisfied within the framework of the financial limits established.

German enterprises have already been able to participate successfully in tenders for European and international space research and thus creating and ensuring qualified jobs—also in regions lacking infrastructures. The FRG Government assumes that this will also be true in the future, although a quantification of the effects on the labor market is not possible at present—in view of the still outstanding decisions.

[Question-14] How does the FRG Government evaluate American estimates of the extent of private economy space acitivity in the year 2000, according to which they will be worth over DM150 billion, of which around DM60 billion will be disbursed just for the communications satellite, about DM75 billion for materials research and materials processing to space and around DM15 billion for marketing geodesic satellites?

Dr Probst: In view of the uncertainty involved in forecasting a relatively young market field 15 years in advance, the study-based estimates presented by the Center of Space Policy in 1984 about economic space activities in the year 2000 is considered, in agreement

with other evaluations, as a value at the achievable upper limit. However, the market trend is growing and will in future depend substantially on the development of transport costs.

[Question-15] What technological breakthroughs and economic effects does the FRG Government expect experiments in space to have in the long run (for example, in the field of pharmaceutical products, alloys, crystals, electronic experiments, etc.) and on what knowledge or investigations does the government base its opinion in this respect?

Dr Probst: The number of experiments of the kind mentioned so far carried out in space is still very limited, just as are further available chances for experimenting. These experimental programs therefore still concentrate exclusively on procedures of scientific and application-oriented basic research in the field of fluid physics, raw materials, biotechnology and process technology, which are expected to have effects on developing new technologies. Any forecast about which of the conceivable technological breakthroughs and industrial uses may be achieved in future, however, is still too early, considering the current level of research.

[Question—16] How does the FRG Government consider the criticism of famous scientists at home and abroad that manned space projects first, present no justifiable cost-benefit properties; secondly, are superfluous, as the majority of the objectives sought through them could also be achieved with unmanned stations; and third, that the achievements of materials research in the space laboratory are not of fundamental importance nor promise any civilian benefits?

Dr Probst: Anyone who follows the discussion for and against manned space flights will realize that the advantages and disadvantages roughly balance themselves out. On the one hand, man should be included where he is definitely necessary, for example, for laboratory work in space, where creative flexibility with a view to experimental parameters is necessary; on the other hand, however, automatic devices must be used wherever possible.

Space laboratory experiments in materials research are a matter of basic research, whose benefit can hardly be estimated at present. All the time that has so far been available for experimenting is too short to be able to make any conclusive judgement. Opportunities for achieving commercially beneficial results in the space station also should not be unexploited.

[Question—17] What basic comparative studies on manned and unmanned space projects from an economic, labor market policy, and technology and research policy viewpoint has the FRG Government so far carried out, and what results have been achieved?

Dr Probst: Appropriate investigations, studies and experiments on the possibilities and limits of using automations and robots for manned or unmanned missions have been conducted with the participation of industry. They show that automation and teleoperation techniques will be increasingly important aids, especially in conducting research, such as experiments under microgravity conditions, in ensuring as efficient a use of human intelligence as possible in space by relieving man of routine tasks and diminishing or avoiding situations that are potentially dangerous for astronauts.

Experiments with a redefined development can also be run completely automatically. A few examples are successful missions in the fields of earth reconnaissance, telecommunications or extraterrestrial research.

[Question-18] What research policy and technological experience was gained from the D-1 mission in fall 1985 and what was the cost to FRG taxpayers of this first large-scale space mission achieved with FRG participation?

Dr Probst: Over 70 scientific experiments from the most diverse disciplines were run during the D-1 mission, which led to interesting results and have already been the subject of several technical conventions and numerous publications. The results indicate promising uses in materials sciences, biology and medicine, which, however, will have to be confirmed in further experiments in view of the brief experimental time so far. The results made it clear that the absence of gravity opens up more efficient research possibilities for hardening processes in metals, composite materials, and semiconductors, for the identification of biological processes and for human medicine. Around DM400 million was spent from the FRG budget for the D-1 mission.

[Question—19] What does the FRG Government expect as a result when it announces the beginning of commercial use of space as "an enormous national effort, which should ensure one of the first places for the FRG in the competition between nations for peaceful conquest of space," and what investigations and studies are the foundations of the government's assumption that commercial use of space makes national and industrial economic sense for exploring and producing new materials and products?

Dr Probst: The FRG Government believes that the FRG as an industrial nation must participate in the technological development of astronautics and exploitation of space. Both German science and industry will only be able to be competent partners in tomorrow's international projects if the necessary prerequisites are already developed today. The development of space travel from its beginnings 30 years ago until today has proved that some fields, such as communications technology, can already be exploited on a commercial basis today. Commercial exploitation of space through the production of

new materials and products is not precisely predictable today, because of the still prevalent research-oriented nature of the experimental work.

[Question—20] How does the FRG Government consider efforts to make West Europe into a 21st century space power; what pan-European, West European, peace and technology policy guidelines form the basis of the government's ideas in this respect; and what effects will a "West European space power" have on East-West relations in the government's opinion?

Dr Probst: The FRG Government expects its funding of space technology to give important impetus to technological, economic, and scientific progress. ESA member states' cooperation serves exclusively peaceful purposes and promotes Europe's integration. Thus, national borders will become increasingly irrelevant for scientific, technological and industrial exchanges within Europe. In its efforts in the field of space technology, the FRG Government does not see itself as a competitor but as a partner for other countries. Development of an independent European space research and technology serves principally to improve international cooperation; the objective is to become a cooperation partner through its own competence.

The agreement about basic principles of scientific-technical cooperation with the Soviet Union opens up prospects for intensifying cooperation in this field, too.

[Question—21] What were the reasons behind the FRG Government's refusal to proceed further and discuss with a broader public all the five alternatives (A to E) presented in the DFVLR space travel strategy study in May 1984, rather than deciding for the C option from the beginning?

Dr Probst: The FRG Government did not in any manner decide for one option from the beginning, but thoroughly discussed all the alternatives presented by the DFVLR with expert advisers. The government's decision dated 16 January 1985 was formulated on the basis of this evaluation.

[Question—22] How does the FRG Government plan to oppose the plans of some countries to enter into space armament and thus space militarization using technologies developed in the framework of civil space travel (e.g. with the aid of earth reconnaissance, communications or weather satellites)?

Dr Probst: Together with numerous other states, the FRG is a signatory of the 27 January 1967 treaty on the fundamentals regulating activities of states in space exploration and exploitation, including the moon and other heavenly bodies (Space Treaty). This treaty sets out the basis for an overall international cooperation in space exploration and exploitation for peaceful objectives. It forbids "launching space stations carrying nuclear weapons or other mass destruction weapons into an Earth orbit and... stationing such weapons in space."

The space projects in which the FRG Government participates are oriented to civil applications. The FRG army participates at the moment with earth-based components in the communications and navigations satellite systems of our alliance partners. FRG's participation in using them contributes to maintaining defense capability. Just like militarily used earth reconnaissance, information and weather satellites, these systems are permitted by the space treaty and have a peace-ensuring function. They improve the transparency of military activities and make a considerable contribution to verifying, that is, to ensuring that armaments control and disarmament agreements are respected. The FRG Government strongly supports the U.S.-Soviet declaration of 8 January 1985 which provided the bilateral Geneva talks, among others, with the objective of "avoiding an arms race in space." The government is in favor of cooperative solutions based on the ABM treaty.

[Question—23] How does the FRG Government evaluate the WEU [Western European Union] Assembly position (deliberation No 410, fall 1984), "that space potential will be a central deciding factor in future warfare, that in military terms the difference in potential between nations with space capabilities and the others will be almost exactly as great as the current power difference between nuclear and non-nuclear nations and that Europe should not only take note of this fact but also do something about it?"

Dr Probst: Together with the other governments of WEU member states, the FRG Government expressed its opinion on the deliberation No 410 of the WEU Assembly in the WEU standing committee's November 1984 response to this recommendation, where among other items, the WEU member states:

—consider avoiding a destabilizing arms race in space as a matter of primary importance,

—stress the continuing significance of the ABM treaty concluded in 1982 and the treaty on the peaceful exploitation of space concluded in 1967,

—emphasize the need for negotiations about limiting and reducing offensive weapon systems, in view of the inseparable connection between offensive and defensive weapons.

[Question—24] In which of the military space projects included in the above-named WEU resolution does the FRG Government intend to participate in the near future, and what steps have been made so far to this end?

Dr Probst: The FRG army participates with earth-based components in the NATO Satcom (Satellite Communication System) and is considering participating in the NATO NAVSTAR/GPS project (Navigation System Using Time and Ranging/Global Positioning System).

Furthermore, the FRG Government examined German participation in the French project for a reconnaisance satellite for military purposes in 1985. In favor of the project is its use as a means of verification, which increases in substance as the armaments control policy between West and East moves forward. The project proposed by France for a joint reconnaisance satellite is not being pursued further at present as no financial means are available for it.

The FRG Government does not intend to participate in other military space projects named in the WEU resolution.

[Question—25] How does the FRG Government view efforts relevant to its compatibility with the ESA Treaty, which provides that the West European space authorities may only consider projects with a clearly peaceful use?

Dr Probst: The FRG Government upholds Article II of the ESA Convention, which provides for cooperation within ESA serving exclusively peaceful objectives.

[Question—26] How does the FRG Government evaluate the position of FRG minister Dr Woerner, who has spoken out in favor of developing West European military satellite programs (see SUEDDEUTSCHE ZEITUNG dated 20 June 1984), and what consequences are linked to this?

Dr Probst: The FRG Defense Minister made no statements about developing West European military satellites on 20 June 1984 in the SUEDDEUTSCHE ZEITUNG.

III. FRG Government Position Regarding the German Society for Foreign Policy Research Institute's Study "FRG Space Policy at the Turn of the Century"

[Question—27] How does the FRG Government consider the report of a group of experts working within the DGAP [German Society for Foreign Policy] research institute dated June 1986, according to which West Europe should be seen as a 21st century space power and the FRG should expand its space policy with a view to this objective?

Dr Probst: The FRG Government sees this document as a contribution to a debate where, in addition to foreign policy considerations, the question of financial resources must be particularly taken into account.

[Question—28] In this connection, what significance does the FRG Government attach to the fact that at the time when the study was published, nine of the 27 members of the aforementioned group of experts were active as secretaries of state, department chiefs, or deputy department chiefs in the competent FRG ministries interested in space policy?

Dr Probst: Apart from the fact that a relatively consistent participation of members of the involved FRG ministries is not surprising, considering the government determining role in funding space research and use, this situation changes nothing in the evaluation of the report as one of numerous contributions to the debate about European space programs. This is also supported by the way the group of experts presents itself in the introduction to the report, which says that "the report...(intends)...to sketch...some answers," is "a first attempt at analysing and presenting the significance of space exploration and use for FRG politics, with the aid of selected experts from research and science, the economy and trade unions as well as from administration and the parliament" and "because of the heterogeneous composition of the group of experts and the often different opinions its members hold, not all details of the report (could) be reached in agreement."

[Question—29] What is the connection between the dismissal without notice of the FRG Ministry for Research and Technology department chief responsible for space policy and the fact that this happened at exactly the same time as the completion of the aforementioned study?

Dr Probst: There is no relationship between the two matters.

[Question—30] What financial consequences would a complete realization of the proposals made in the aforementioned study have, and how does the FRG Government consider the fact that the so-called "group of experts" makes no statements about possibilities for financing its far-reaching proposals, but limits itself to this plain paragraph in its study: "The proposed considerable intensification of FRG space activities cannot be financed by juggling inside the BMFT budget. Rather, extra financial resources must be put at the disposal of the BMFT and of other ministries responsible for using space."?

Dr Probst: The FRG Government does not know the accounting documents at the basis of the DGAP study and therefore does not judge them. The FRG Government considers that those who drew up the study expressed their personal opinions in terms of the documents presented to them.

[Question—31] Does the FRG Government agree with the case made by the aforementioned study which, according to a press release dated 24 June 1986, assumes "that as a result of the FRG's exploitation of space, new business fields and innovative effects for the whole economy will arise and extra jobs can be created." How

does the FRG Government consider the basic accounting assumptions (mostly missing in the study) for this assumption, and in which other places does the FRG Government's position differ from the mostly ideology based study, full of gaps and dictated by ideas of space policy prestige?

Dr Probst: For the FRG Government's opinion about possible exploitation of space, I refer you to the answer to question 19.

In reference to an evaluation of the DGAP study's basic accounting assumptions, I refer you to the answer to question 30. Furthermore, the FRG Government is not in a position to assess all expressions of opinions in detail.

[Question—32] How does the FRG Government evaluate the minority votes expressed by two members of the group of experts, Professor Dr Klaus von Schubert (from the research institute of the evangelical study society) and Siegfried Bleicher (former executive committee member of the FRG trade union federation)?

Dr Probst: The FRG Government considers the minority votes expressed by Professor Dr von Schubert and Mr Bleicher in the same way as the overall report of the group of experts to which they belonged, as contributions to the space debate worthy of being taken into consideration.

The minority votes of the two members of the experts' group demonstrate that it was possible to express divergent opinions within the group.

[Question—33] How was the participation of high ranking "experts" from the FRG ministries of foreign affairs, defense, research and technology, economics, and post and telecommunications agreed to with the ministers respectively responsible for these portfolios, and how does the FRG Government intend to face the immeidate impression that, considering the relevant number of "experts" from the five FRG ministries concerned with space research and policy, the concepts expressed in the report by no means repeat "the personal opinions of the indicated people," but the position of the FRG Government?

Dr Probst: In view of the answer to question 28 and the report introduction quoted both there and in question 33, the FRG Government sees no danger of an impression arising automatically that the opinions expressed by a group of experts with members of some FRG ministries mirror the FRG Government's position.

[Question—34] Does the FRG Government agree with the "group of experts"' concept that a "space awareness" must be generated and promoted in the "German population," and what measures does the FRG Government intend to use in this respect?

Dr Probst: The FRG Government is aware of its duty to inform citizens about its activities, to which space research and technology funding also belongs. It is the FRG Government's objective to inform them impartially about activities funded with tax revenues and thus to support them in making their own evaluation and forming independent opinions.

IV. FRG Participation in the French Hermes Space Shuttle Project

[Question—35] Is the January 1985 cabinet decision in connection with approval of Ariane 5 and Columbus still valid: "With the development of these two programs, the FRG Government's possibility to undertake civil space travel projects of a comparable size is exhausted, under present circumstances," or what circumstances have since then produced enough to undertake a further space travel project of comparable size?

Dr Probst: The FRG Government's January 1985 decision referred to FRG participation in the preparation programs for Columbus and Ariane 5. The cabinet reserved its decision about participating in the continuing programs pending the results of the preparatory programs, with special regard to respect for the budgeted cost and in consideration of the positions adopted by its partners.

In the meantime, intermediate results have also been presented for the preparatory program of the Hermes space shuttle, which complements Columbus and Ariane 5 in a coherent space flight system. The proposals that the ESA director general made for the continuation of the three programs, based on the intermediate results of these preparatory programs, are currently being checked.

[Question—36] How much a) public and b) industrial budget funding has already been disbursed in past years—divided year by year—in West European countries, especially in France and the FRG, for preliminary work for the Hermes space travel project?

Dr Probst: France proposed Europeanizing the Hermes project in 1985. DM229 million is being spent within ESA for the current program running until the end of 1987 (1986: DM30 million, 1987: DM109 million, 1988: DM90 million) which is financed by the participating member countries. The FRG is allotted a contribution of DM60 million.

France had prepared the project at a national level for several years. Official figures about the specific utilization of financial resources there and in other European countries are not available.

[Question—37] How high was the "FRG industry participation corresponding to the FRG participation share" claimed by the FRG Bundestag Budget Committee in 1986/1987, and how high will this participation

share be in 1987, inasmuch as the costs for Hermes and its respective preparatory program have risen once again by an extraordinary amount from 1986 to 1987?

Dr Probst: The FRG participates in the Hermes preparatory program with a 30 percent contribution. In accordance with ESA regulations about industrial feedback, FRG industry thus processes a corresponding contract volume.

[Question—38] What "technical key elements" or other facts that were not yet known in summer 1986 are responsible for the extraordinary cost increases in the Hermes project, and what preventive measures has the FRG Government undertaken in order to be able to avoid such increases wherever possible in the future?

Dr Probst: The current Hermes preparatory program serves the definition of the Hermes program in terms of technology, schedule, and costs. It is especially used to check the original cost estimates and wherever necessary any revision of these assumptions as the basis for decisionmaking about the development program. The consequences of the Challenger disaster were a substantial reason for the increase in cost estimates against the original assumptions, as they made increasing safety requirements in Hermes and a thorough amendment of technical concepts necessary.

[Question—39] What reasons has the French Government supplied since 1983, within the ESA and directly to the FRG Government, to obtain a positive decision from West European countries for the Hermes space shuttle project?

Dr Probst: The French Government considers a manned transport facility for going to and returning from space to be essential within a coherent European space travel program whose objective is to guarantee Europe the option of autonomy in the long term.

[Question—40] What costs does the FRG Government foresee for the space shuttle project by the year 2000, and how does it intend to raise this?

Dr Probst: The ESA has developed a program proposal for the European space shuttle Hermes on the basis of the intermediate results of the preparatory program, which demonstrates development costs on the order of DM9,520 million (1986 quotations). A subsequent qualification program, already reaching beyond the turn of the century, is estimated at a further DM580 million. No decision has as yet been made about the Hermes development program itself, or about the nature and extent of any FRG participation.

[Question—41] What costs can be foreseen for additional expenses that become necessary in connection with Hermes, the worldwide data relay system, the extension of the national and European space travel infrastructure, new requests for the Ariane 5 launcher and, where necessary, new construction at the West European Space Center in Kourou?

Dr Probst: The necessary infrastructure measures for development and launch extensions are included in the figures mentioned in the answer to question 40. The program proposal developed by the ESA for Ariane 5, which totals DM7,515 million (1986 quotation) for the development phase, also includes the necessary measures for qualifying the launcher for transporting the Hermes space shuttle. The European data relay satellite system currently being investigated in preliminary studies will be a key element of the entire infrastructure, so it will also be used in running the Columbus program element and the service programs needed for earth observation.

[Question—42] What cost-benefit comparative calculations are available to the FRG Government for possible alternative projects (use of the U.S. space shuttle with 18 metric ton payload as compared to Hermes' maximum 4.5 tons, space capsules, etc.), and why does it still favor the Hermes space shuttle project?

Dr Probst: While the American shuttle was designed both for transporting a crew and for transporting large unmanned payloads, such as satellites, Hermes is planned principally for transporting a crew and a limited payload. According to the European concept, it is more cost effective and safer to transport large unmanned payloads with a launcher such as Ariane 5. Considerations made in the United States after the Challenger disaster agree with this European concept.

[Question—43] Does the FRG Government agree with the opinion of the FRG Minister for Research and Technology that a FRG participation in the planned French space shuttle Hermes is not justifiable in terms of research policy, as research funds would thus be invested in a "technology of the past" which would no longer be competitive with newer American developments for space transporters at the turn of the century (see SUEDDEUTSCHE ZEITUNG dated 23 February 1985)?

Dr Probst: The ESA has revealed that technological fields would be covered with Hermes where very little experience is available on the European side, especially in the fields of hypersound-aerothermodynamics, complex flight guidance and navigation, re-entry problems at earth atmosphere and life support systems.

It should be noted here that the USSR is currently developing a mini-shuttle and a space vehicle of comparable size to the U.S. shuttle. Japan is also testing the development of a space shuttle with similar dimensions and tasks as Hermes. The United States itself has not yet made any decision about the technical conception of a space shuttle follow-up project; various alternatives are being tested.

[Question—44] On what grounds did the FRG Government decide against unmanned re-entry systems such as re-usable space capsules, which are also proposed in the DFVLR memorandum "European Re-entry Space Transport System," dated December 1985 (p 41 onwards), and what experience has been gained in other countries with the space capsule system?

Dr Probst: The re-usable space shuttle Hermes proposed by France is so far the only manned re-entry system developed in Europe and subject to consideration. The FRG Government participates in the ESA Hermes preparatory program, but has reserved its ultimate decision about participating in the overall project until the technical and financial questions connected with it have been answered.

The BMFT currently is also investigating the possibilities of introducing unmanned re-entry capsules, and the related main applications, that is the retrieval of the experimental achievements in materials sciences and biology conducted in space. With this kind of system, the time until lift-off of Spacelab missions like D-2 for experimental programs in microgravity could be bridged. For many tasks, however, such experimental flights represent only an emergency aid, as they cannot replace the functioning of complex installations where human intervention is necessary.

Furthermore, private industry in the FRG and Italy is currently preparing a project, TOPAS. In this project, unmanned re-entry capsules that can be acquired on the U.S. market are used for experiments under microgravity conditions.

[Question—45] How does the FRG Government judge further criticism of the Hermes project frequently expressed in experts' circles, such as:

—Hermes' technological backwardness compared to U.S. systems,

—the considerably higher price for supplying a permanently manned European space station because of Hermes' smaller payload compared to American space shuttles,

—the lack of long-term availability of the West European Space Center at Kourou in French Guyana,

—this space center's unsuitability, as sensible use and recuperation payloads cannot be reached from there,

—extra costs for emergencies that will be necessary for orbits that are incompatible with U.S. orbits?

Dr Probst: The FRG Government will proceed to its evaluation of Hermes in connection with its decision about participating in a development program.

In ESA programs, Hermes as a space shuttle is substantially different from the concept of the [American] space shuttle as a space transporter. Its smaller payload has been designed for its flight task of shuttling astronauts back and forth into space for research and maintenance tasks. The payload transport for building and supplying space stations with large unmanned payloads is to be done by the European Ariane launcher. Separation of manned operations from payload transport is aimed at reducing costs and enhancing safety.

Because of its proximity to the equator, Kourou is an almost ideal launching pad for satellites in geostationary orbit, in comparison to all the other launching pads worldwide, [since] the greatest payloads can be launched from there using the same launching thrust. Kourou offers this advantage also for polar orbits, all the more so since limits must be observed by American launching pads on the grounds of necessary safety zones over inhabited areas. A launching pad near the equator is also desirable for horizontally launched booster systems for economic reasons. The loss in payload when transporting into orbit to the space station is not considerable.

There are no costs for emergency measures that might arise from orbit deviations, as the European Columbus elements fly the same orbit as the international space station.

The FRG Government is not concerned about the long term availability of this launching site.

[Question—46] How does the FRG Government consider the criticism of Hermes that was to be understood from the position taken during the FRG Industry and Commerce Conference [DIHT] on 13 October 1986, and does the government consider the DIHT's motivation for nevertheless pronouncing itself in favor of Hermes to be plausible?

Dr Probst: The FRG Government is taking every constructive criticism into account in its considerations for the imminent decision. This also applies to the position taken during the DIHT. As the government has not yet undertaken its conclusive evaluation, it cannot as yet take any position with respect to the details outlined in the DIHT's policy paper.

[Question—47] Does the government agree with the DIHT's opinion that "in view of the dimensions of the expenditures involved, in this case, the question of whether Hermes/Ariane, Hotol and Saenger should be developed together or one after the other should not be decided in a hurry," and does it intend to use the analysis mentioned in the paper to check whether Hotol or Saenger can be developed relatively independently from a prior Hermes/Ariane project?

Dr Probst: The FRG Government agrees with the DIHT's opinion that these extremely difficult questions should not be decided under pressure.

According to the ESA understanding of the technical development possibilities of the Saenger and Hotol proposals and their resulting schedules, the thrust motor development in particular still requires a long technological preparatory phase.

[Question—48] How does the FRG Government evaluate France's military interests in Hermes, and in this respect is it still considering to establish an FRG-France planning guidelines for coordinating civil and military space projects?

Dr Probst: The FRG Government is not aware of any military interests of its French partner in Hermes. With realizations in the ESA framework, it goes for Hermes as for all ESA projects that it is developed for exclusively peaceful purposes.

[Question—49] Is the FRG Government aware of plans in the CDU/CSU parliamentary group [Christian Democratic Union/Christian Social Union] about using Hermes also for projects on behalf of the FRG Ministry of Defense, and how will it respond to such requests?

Dr Probst: The FRG Government is not aware of any plans of this kind.

[Question—50] What conclusions does the FRG Government expect to draw from the June 1985 planning study of several aerospace enterprises on "a project for a future European launcher" which again proves that the Ariane 5, planned as the launcher for Hermes, will remain at the technological level of the 1960s, and proves to the FRG Government that it has followed blindly the French lead in this multi-billion [-DM] project without investigating the alternatives?

Dr Probst: The objective of the Ariane project is to prepare a reliable, cost effective, marketable European launcher for larger payloads. Within the ESA framework, alternatives to this launcher have also been investigated whose commercial success prospects may not be jeopardized by excessive technical risks. The success that the Ariane family 1 to 4 has had on the international space market speaks for itself.

The new development of the HM60 liquid oxygen/liquid hydrogen propelling system should further increase the rocket performance.

[Question—51] What economic and military applications can the FRG Government imagine in view of the aforementioned factors, and how does it evaluate the concept of the Greens that a decision in favor of Hermes would indicate a development where billions [of DM] would be put in a bottomless pit for questionable reasons?

Dr Probst: A military demand for manned space stations on the part of the FRG army is not indicated.

As long as the FRG participates in space projects, these will only be concerned with future possibilities for scientific, technical, and economic purposes.

V. FRG Participation in the American Space Station With the ESA Module Columbus

[Question—52] What were the results of the FRG Government examination of those conditions that were expressed in the United States after President Reagan's January 1984 plan to build a permanently manned space station with the participation of other countries within 10 years, such as

—the criticism expressed by the National Academy of Sciences space committee: "we see no scientific benefit in a manned space station in the next 20 years," or

—the opinion growing within American industry that practically all current space projects can be carried out by unmanned space vehicles at least as well as, sometimes even better and cheaper than by manned stations?

Dr Probst: It is known that some American scientists, especially from the National Academy of Sciences, have criticized American space plans and that the concept is presented that space science is thus being shortchanged. No criticism common to American scientific organizations, such as the National Science Foundation, the National Research Council or the National Academy of Sciences, is known to the FRG Government. Also the statement about American industry's evaluation of plans for space station does not apply in this general form.

The question of the FRG's participation in the space station proposed by the United States was carefully tested. Thus the "space travel strategy study" mentioned in question 73 led in 1984 to recommendations whose most important points still belong to the basic principles of national and European space travel policy.

In the same year, the Pinkau committee similarly recommended cooperation with the United States in the field of manned space flights in order to keep Europe's options of an independent manned and unmanned system open in the longer term in the interest of a wide range of possible applications of space travel.

[Question—53] In the opinion of the FRG Government, for what reasons (economic, military or simply national status symbolic) is the currently pursued project for an American space station with international participation run, and how does it evaluate these reasons?

Dr Probst: On 25 January 1984, U.S. President Reagan assigned the contract for constructing a space station with international cooperation to the American space agency NASA with the following words: "...We can follow our dreams to distant stars, living and working in space for peaceful economic and scientific gain. Tonight I am directing NASA to develop a permanently manned

space station and to do it within a decade. A space station will permit quantum leaps in our research in science, communications, and in metals and in life-saving medicines which can be manufactured only in space. We want our friends to help us meet these challenges and share in their benefits." The FRG Government has accepted the U.S. offer.

[Question—54] What is the FRG Government's approach to the thesis established within the FRG Society for Foreign Policy [DGAP]: "The FRG must ensure its place in the space club, all the more so since it is not and cannot be a member of the atomic club for relevant political reasons" (see EUROPA-ARCHIV 21/1986, p 638)?

Dr Probst: The FRG Government's space policy has no connection with the fact that the FRG is "not a member of the atomic club."

[Question—55] What investigations back up all those promises upon the basis of which the FRG Government decided on 16 January 1985 to participate in the space station with the Columbus module (see DNFT-MATERIALDIENST No 4/85: Documents for the FRG cabinet decision on space policy)?

Dr Probst: The FRG Government does not decide on the basis of promises. The cabinet decision of 16 January 1985 was made on the basis of exhaustive technical preliminary investigations. To this end, there was no doubt that participation in a development program should only be decided after the presentation of the results of a basic preparatory program.

[Question—56] How will the FRG Government avoid a development taking place in the United States where the ESA (and thus the FRG) plays the role of Mr 10 percent in taking part in the space station built under American leadership?

Dr Probst: Together with the other European governments participating in the Columbus project, the FRG is conducting negotiations with the U.S. Government on the basis of the cabinet decision of 16 January 1985 and of the ESA Council decisions at ministerial level of 31 January 1985, which assume the cooperation to be based on a true partnership and whose goal is the development of an international space station. The type and extent of cooperation will have to be decided definitively after the results of the related negotiations have been presented.

[Questions—57,58,59] With what results have the tremendous differences of opinion between West Europeans and Americans about the space station phases C and D been resolved in the meantime, especially with reference to:

—the application of U.S. law in the entire space station,

—the use of discoveries and concession of patents arising from the work carried out in the space stations,

—the organization of the West European participation in Columbus for experiments both in materials research and in biological sciences,

—the binding establishment of a cost framework, including an agreement about how to share the running costs?

On this basis, how does the FRG Government judge efforts to make the space station become the focal point of the U.S. space program and "not just an international community project," which reveal the aforementioned intention of international partnership with equal rights to be waste paper?

During the debates between the United States and other countries in Washington at the beginning of February 1987, what "agreement" was reached about the aforementioned individual problems and what other questions are still being discussed at present?

Dr Probst: The negotiations with the United States have not yet been completed. The FRG Government does not normally present or evaluate the point reached by national negotiations in course, in which several countries are taking part.

[Question—60] Is there any truth in the press reports that estimated costs for the planned space station amount to about DM25 billion, of which around DM6 billion would have to be contributed by the West Europeans, or otherwise what financial requirement does the FRG Government expect for the 1990s?

Dr Probst: The National Research Council Committee on the Space Station is currently conducting a study on behalf of the U.S. Government about the space station in terms of demands, performance, costs and schedules.

NASA cost estimates so far presume an overall cost of about $16 billion (1984 quotation).

Europe's financial contribution to the Columbus program is estimated to be worth about DM7.5 billion.

[Question—61] How does the FRG Government assess the study conducted by the American Institute of Aeronautics and Astronautics for the Air Force Space Technology Center in which, according to the INTERNATIONAL HERALD TRIBUNE of 9 April 1987, p 7, "dozens" of military activities, such as "tanking up" SDI weapon systems, combat guidance, military systems repairs, etc. are being sketched out in the space station?

Dr Probst: Regardless of any press reports, the U.S. Government has stated its position in negotiations with the other interested governments, that the space station should be constructed and run for peaceful purposes in accordance with international law.

[Question—62] Is there any truth to the report that even after the negotiations between the ESA and NASA in Washington on 11-12 February, the U.S. Government still reserves the right to use the space station for all purposes, including those of national security? Does the FRG Government have access to any information that the United States also wants to use the space station for SDI research?

Dr Probst: The FRG Government has no information to the effect that the United States also wants to use the space station for SDI research.

[Question—63] How does the FRG Government judge American reports that, in the latest draft of an agreement between NASA, the ESA and Japan about using the space station, although "the use for peaceful purposes in accordance with international law" is provided for, it is nevertheless further expressly stated in the framework of an appendix: ("Such utilization may include national security use")?

Dr Probst: The responses to questions 56 through 59 are also valid here.

[Question—64] How did the FRG Government react when the American Defense Department's list of requests for using the space station became known in May 1987 (see AVIATION WEEK & SPACE TECHNOLOGY, 4 May 1987, "Pentagon Describes Possible Military Station Experiments")?

Dr Probst: Such a list of requests has been communicated neither to the FRG Government nor to its European partners.

[Question—65] How does the FRG Government assess the opinion of the research policy spokesman of the CDU/CSU parliamentary group, Lenzer, according to whom FRG astronauts should conduct research both for civil and military objectives in the space station (see KOELNER EXPRESS, 5 July 1987)?

Dr Probst: The identification of objectives in Article II of the ESA Convention ("for exclusively peaceful objectives") is valid to enhance a European participation in an international space station.

[Question—66] Under what conditions is the FRG Government prepared to seal an agreement to carry out phases C and D of the planned space station, or does the government consider it possible—if yes, on what conditions—that, however, there will be no participation of the West Europeans in these phases?

Dr Probst: The conditions for participating in the international space station with the European Columbus program are formulated in the cabinet decision dated 16 January 1985 and the decision of the ESA Council at ministerial level dated 31 January 1985. The results of the negotiations will be assessed in due course on the basis of these decisions.

[Question—67] How many space transporter flights are necessary, to the FRG Government's knowledge, to locate the planned international space station in space and what are the consequences, to the government's knowledge, of the fact that the United States will give clear precedence mainly to military payloads in shuttle missions after 1988?

Dr Probst: According to NASA plans, 17 to 19 space flights are necessary to build the space station. Because of a mixed space transporter fleet consisting of space shuttles and traditional rockets, when the time comes, the United States is expected to be in a position to execute all the necessary space shuttle missions according to schedule.

[Question—68] What investigations has the FRG Government carried out to discover to what extent alternatives to participating in the American space station are feasible, with what technical means and at what costs they could be carried out, and with which international partners they could be completed in how much time?

Dr Probst: In view of the continuing negotiations with the United States about participating in an international space station, any discussion about alternatives would be at least premature. However, the FRG Government is making careful preparations and is in close contact with the other participating ESA governments for the appropriate decisions to be made by weighing the alternatives after the conclusion of the European-U.S. negotiations.

VI. Future Projects and FRG Scientific Program

[Question—69] Has the FRG Government already expressed an opinion on the "Pioneering the Space Frontier" report presented in May 1986 to the President of the United States by the National Space Commission, and what is it?

Dr Probst: In view of its very long term objectives and more pressing, immediate tasks, the FRG Government has not as yet expressed any opinion on the aforementioned "Pioneering the Space Frontier" report as the analyses have not yet been completed. No opinion has yet been presented by the Administration in the United States, either.

[Question—70] Which of the projects proposed in the report, such as supersonic aircraft or projects for moon and Mars settlement, seem to the FRG Government to be worth following up for which civil or military objectives?

Dr Probst: A concrete assessment of future manned moon and Mars missions only appears to be possible when sufficient experience has been gained with a space station.

The future use of supersonic transport aircraft which, depending on the selected speeds, have more or less technical details in common with horizontal launch space transport systems like Saenger, is being tested by the FRG Government through its own studies and analyses of foreign studies. Results so far indicate that at least for the hypersonic field, space travel developments can become increasingly important as technological prototypes for aeronautics.

[Question—71] What surveys and with what results has the FRG Government so far carried out on the two-tier Saenger project? When does it intend to discuss the respective considerations more intensively in public and in Parliament?

Dr Probst: As to the Saenger project, conceptual studies are underway that are still so near to the beginning that any discussion of the results in public or in Parliament is still premature.

[Question—72] What technological, economic, and conceptual assessments are so far at the basis of the British single stage space aircraft Hotol, and how does the FRG Government consider demand and feasibility for this project.

Dr Probst: What was said about Saenger is valid for Hotol all the more strongly, as too little information is available about plans for the British single stage space aircraft for the FRG Government to be able to undertake any assessment.

[Question—73] What consequences in foreign, peace and technology policies does withdrawal from any further manned space projects imply in terms of alternative E of the DFVLR's May 1984 "Space travel" strategic study?

Dr Probst: The development of the alternative E of the DFVLR's "Space travel" strategic study would run into trouble on account of a far-reaching disassociation of the FRG from the community efforts of European countries in an important sector of technology. We would no longer be a partner to be taken seriously in this field by Europe, the United States, the Eastern bloc and other third countries. This would also have consequences for the status of the FRG's foreign policy.

[Question—74] When does the FRG Government estimate that the space probe Ulysses can be launched, which is to be used to explore the solar system and whose launch was originally planned for 1983?

Dr Probst: To free itself from an elliptical orbit the solar polar probe Ulysses needs a Jupiter flyby. For this reason, this probe, like Galileo, can only be launched in "launching windows" when the Earth has a favorable position with respect to Jupiter. Ulysses is a bilateral ESA-NASA project, where NASA contributes cost-free launches to ESA. NASA has planned the Ulysses launch with the space shuttle for October 1990.

[Question—75] What are the reasons for the continuous delays to the Ulysses launch and how much longer can the launch still be delayed, in view of the fact that the radio isotope generator (RTG) necessary for the power supply will only function for a few more months?

Dr Probst: The reasons for the Ulysses project launch delay were, on the one hand, the unavailability of shuttle launch installations due to the Challenger disaster and, on the other, the allocation of the Jupiter launch window to Galileo and Ulysses. The Ulysses launch date now firmly planned by NASA for October 1990 still guarantees the complete mission as well as the power supply through the radio isotope generator (RTG).

[Question—76] What costs have been involved so far for the Ulysses project and what are the additional costs for a new RTG?

Dr Probst: The ESA financial expenditure for Ulysses is DM338 million (1986 quotation). The FRG contribution to this sum is DM81 million. NASA is financing the launch and the RTG. A new RTG would cost NASA about $35 million.

[Question—77] According to the information available to the FRG government, when will the FRG-U.S. Jupiter probe "Galileo" and the Venus probe "Magellan" be launched, and what is the scientific value of these two probes?

Dr Probst: Jupiter probe Galileo launch: October-November 1989. Venus probe Magellan launch: spring 1989.

Galileo will investigate the chemical composition and the physical condition of Jupiter's atmosphere, its moons, and the structure and dynamics of its magnetosphere.

Magellan will increase knowledge and comprehension about Venus and its surroundings through radar cartography, determination of the planet's form and measurement of the planetary field of gravity.

[Question—78] What costs have so far been met for Galileo and what scientific consequences would a complete cancellation of the Galileo launch have?

Dr Probst: NASA expenditures for Galileo so far total about $700 million. FRG expenditures are running at about DM75 million.

The scientific consequences of a cancellation—which is, however, no longer considered since the new launch timetable was set—consist of interrupting Jupiter research worldwide with serious consequences for the participating scientists from the United States and the FRG who have been working on this very ambitious project since 1978.

[Question—79] What truth is there to the press reports that the FRG X-ray satellite "Rosat" can be launched into space in the first quarter of 1994 at the earliest (launch originally planned in September 1987), and what scientific, technical, financial, and organizational consequences would such a delay entail?

Dr Probst: The quoted press report is out of date, as NASA has decided that the X-ray satellite Rosat will now be launched with a launcher instead of with the shuttle. The launch will take place early in 1990. This delay has increased costs by DM20 million in comparison with the launch originally planned by the FRG, for fall 1987. A plan has been developed for the new launch schedule that minimizes the negative scientific, technical, and organizational consequences.

[Question—80] What negotiations are under way with NASA to obtain an earlier launch for Rosat—with what consequences—and when will these negotiations be completed?

Dr Probst: The BMFT has negotiated continuously with NASA for the earliest possible launch date. The result now reached is in our opinion the earliest launch date possible for NASA. It will cause NASA increased costs in the range of $90 million.

[Questions—81,82,83] What plans does the FRG Government entertain concerning the expansion of the FRG Experimental Institute for Aeronautics and Astronautics [DFVLR] into an FRG "national space agency," what financial and technical consequences are connected with this, and in which towns in the FRG will parts of such a national space agency be placed?

Does the FRG Government agree with the opinion of the research policy spokesman of the CDU/CSU parliamentary group, Lenzer, about the tasks of a "national space agency:" "The FRG NASA will not limit its work to industrial research and production and civil earth reconnaissance only, but will also take on military tasks" (KOELNER EXPRESS, dated 5 July 1987); if not, then what counterproposals does the FRG Government consider in this respect?

What reasons cause the FRG Government to favor the plan for a "national space agency" and what arguments in the relevant IABG study presented by the BMFT in January 1987 did not convince it?

Dr Probst: The IABG study presented on behalf of the BMFT in December 1986, "Decisionmaking Structures and Decisionmaking Processes in the FRG's Aerospace Field" strengthens the FRG Government's belief that improvement is needed in the FRG organizational prerequisites for safeguarding FRG interests in international cooperation, especially with regard to the ESA, as well as for program planning and execution in view of the ESA's large-scale projects. Considerations about this have not yet been concluded. There is no intention of expanding the FRG Experimental Institute for Aeronautics and Astronautics into a national space agency. The definition of tasks, competences, the structure and head office location of any such organization to be established are still open.

[Question—84] What measures for a general estimate and evaluation of technological consequences of all aerospace projects has the FRG Government undertaken as a result of the Challenger disaster and what results are already available? Further, how does the government evaluate the proposals of the Greens charging that without such a fundamental estimate and assessment of technological consequences all economic, technological, and financial risks of further space travel projects are no longer defensible on a socio-political level?

Dr Probst: The technological and financial risks of every FRG space project or project with FRG participation are analysed thoroughly before the project begins. As far as possible, political, economic, and general social basic conditions also are considered and analyzed. Of course, there have only been a few aerospace applications so far, such as in the field of telecommunications, where such concrete statements can already be made today about their benefits such that reliable cost-benefit analyses can be adequately prepared.

The FRG Government believes that an FRG participation in space research and the development of space technology is necessary and defensible both in terms of economic and technological factors and from scientific and general social viewpoints.

08702

FRG Group Maps National, European Programs for 21st Century

Outline of New Suggestions

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[Article by Goetz Wange: "Finger on the Pulse of the Times—Space Technology: German Ideas for the Next Millennium"]

[Text] The Europeans have adopted an ambitious program for the next 12 years, with the Ariane 5, Hermes, and Columbus. With their "Guideline Framework for Space High Technology" (OHR) the Germans are already aiming at projects beyond the year 2000.

If you want to harvest, you should sow in good time—that is true also of astronautics. Hitherto the French have tilled their fields especially capably within the framework of the European outer-space organization ESA [European Space Agency]: Within a financially well-endowed national program the seeds germinated, the young plants grew up under the care of the Community, and when it came to harvesting the finest and most nourishing fruits fell into the order basket of the well-organized French industry. That will be the case also following the decisions of The Hague, where with the heavy-load launch vehicle Ariane 5 and the manned space glider Hermes two young charges of the French have been handed over for rearing to maturity. The space station components of Columbus bear a German label only as a package—but the best fruits will have to be shared with Italians, the French, and probably also the British.

What is going wrong in the FRG? It would certainly be too simple to make the lack of a policy plan alone responsible for this. In the past, all of the participants—the research ministry, the DFVLR [German Research and Development Institute for Air and Space Travel], industry, and the universities—have gotten caught up too much in the guerrilla warfare of their own self-interests. Often their strength was already exhausted when it became important on the European stage to get other countries get aboard their own boat. Much, perhaps too much, is being expected of the German Space Agency that, according to information from the cabinet, is to be founded this spring. But possibly the "German NASA" will be helped by the initiative of a working group made up of universities, industry, and the DFVLR, which with its "Guideline Framework for Space High Technology" (OHR) has made proposals for a concentrated national technology and study program. Requested scope of financing: About 10 percent of the public funds that are being spent for astronautics should be spent to materialize this German strategy concept. This would be about DM 220 million annually around the turn of the millennium.

Substantial Lowering of Launching Costs

Let us not give the wrong impression: The German planners remain far behind that which the National Commission on Space, on orders from the American President, has formulated in its report "Pioneering the Space Frontier" as a long-range objective of the United States for the next 50 years. In that report, the imagination of serious scientists envisions manned bases on the moon and Mars coming into being by the third decade of the 21st century. As a prerequisite for this, low-cost transport vehicles and the further development of the space station into an "outer-space port" with corresponding transfer craft for further transporting are to be developed within the next 20 years.

Certainly it is the intention of the OHR strategists for the European space train to travel in the same direction—"The common motivating force is a further venture into outer space for the exploration of the earth, the solar system, and the universe, in order to expand the direct material benefit to mankind on the earth, and finally for the sake of tapping and utilizing extraterrestrial resources," describes Professor Carl-Jochen Winter, member of the DFVLR managing board and chairman of the OHR steering committee—but the objective is somewhat less spectacular. The fact that he of all people is committed to this initiative and has untiringly championed it should be regarded as a good omen: Professor Winter—originally sent from the BMFT [Federal Ministry for Research and Technology] to the Stuttgart DFVLR center in order to do away with its remaining space activities—has seen the light on the wave of the increasing popularity of space travel.

The decisions of The Hague—according to Professor Winter—must not lead the planners to now remain idle. "Outer-space travel is of a long- wavelength character," stresses the DFVLR man. "When one considers that 15 to 20 years lie between an idea and its realization, for a nation to have a head start in conception and technology becomes all the more important."

The OHR study mentions as one of the important prerequisites for future European space activities that of a substantial lowering of the transport and operating costs. At the same time, the safety and reliability of the systems must be increased and the prerequisites must be created for longer stays by humans in space.

On the initiative of MBB [Messerschmitt-Boelkow-Blohm], with the system Saenger II a two-stage concept from Germany is already on the drawing boards, with which typical transport costs in low orbit (450 km in altitude) could be lowered to a third of present levels. Particular appeal of the proposal: By intention the first stage is largely similar to a hypersonic passenger aircraft that could transport about 230 people at a cruising speed of Mach 4.5.

Also of interest are ideas about building a large rocket, likewise with two stages, on the basis of the Ariane technology; in this design, the first stage can return to earth after burn-up and be reused. Here Dornier has gotten an inspiration from earlier ESA studies and American concepts, and has added to the discussion about the EARL (European Advanced Rocket Launcher). The unmanned cargo version with about 18 tons of payload remains within the capacity range of the Ariane 5 for low earth orbit. Since the expensive first stage, with several propulsion units and costly control electronics, can land like an airplane when its work is done by way of an additional turbofan drive, a lowering of transport costs by 50 percent could be expected compared to Ariane 5.

The Key Lies With the Propulsion Units

The OHR study avails itself of the descriptions of such systems merely to foster an understanding of the technology developments that are to be derived from them.

Above all there is the category of propulsion: With Saenger or similar concepts, in order to cover the wide Mach range a combined propulsion system is needed—in the low speed range up to Mach 5, turbo engines or subsonic ramjet engines are brought into use, but thereafter a propulsion system, the scramjet (supersonic combustion ramjet) or a combination of scramjet and scramrocket, must be used. No longer, as with the ramjet in the subsonic region, is the air braked and compressed for combustion of the liquid hydrogen, but instead the hydrogen is burned directly in the less hot supersonic stream.

The technical problems associated with this are immense. Examples are the use of carbon/carbon materials with heat protection layers, as well as air inlets and expansion nozzles having an adjustable geometry, in order to be able to optimally adapt the propulsion unit to every speed range and every flight altitude. Corresponding high-altitude test rigs may possibly run into trouble for technical reasons or because of costs. Following the American example of the X-30, thought is being given to building a flying test-rig vehicle.

The tanks of future space transporters should be as light as possible, but at the same time in the ascent through the atmosphere and in reentry enormous aerodynamic and thermal loads must be withstood. Materials and designs must be developed that can withstand about 1,400 degrees Celsius without extra protection. Fiber-reinforced ceramics are being considered as key materials.

Politicians are Calling for More Guidance

The development of the robotics and rendezvous technology will also make up a large fraction of this work. OHR is thinking of completely automatic servicing vehicles that—equipped with manipulator arms—are to refuel and service platforms in geostationary or polar orbits. Unmanned and mannable service vehicles are to be carried by electrical drives from the space station up to the geostationary orbit at an altitude of 36,000 km. There, enormous observation platforms and communications relays will be stationed, for which antennas with diameters of 30 to 100 m are to be constructed.

If people are to stay for long periods in outer space, life-support systems must be designed that can regenerate their resources at least partially by means of closed cycles. This extends from the repurification of process water and oxygen to the growing of edible plants in the space station. For the energy supply, large-area solar generators, high-performance batteries, and gyro wheel accumulators as well as the safe use of nuclear reactors must be investigated.

The Guideline Framework for Space High Technology gives accounts of a bunch of technology emphases and alternatives. For politicians, this is apparently already an excess of things offered. Thus, although chief of section Dr Horst Hertrich of the BMFT praises the initiative, nevertheless he cannot discern a clear guidance, despite the choice of name. Now in a second round the hard-working OHR planners want to give recommendations for selected technology emphases. One can only hope that at that time they will find a sympathetic ear in Bonn.

Details of Proposed Next Generation Launcher

36980177 Stuttgart FLUG REVUE in German
Jan 88 pp 28-29

[Article by Goetz Wange: "Rocket Idea from Dornier—The Catchword Is a Lowering of Costs of Transport into Space: Dornier Presents a Study on a Winged Return of the First Stage"]

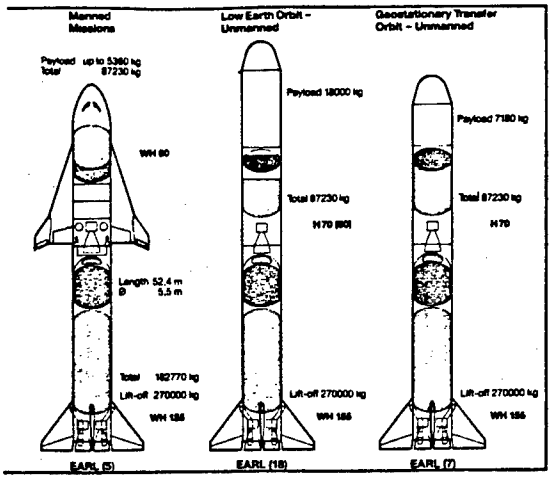
[Text] No sooner had the decision been made in the Hague for the next generation of European transport systems into outer space when the astronautics firms were already getting on their marks again for the follow-up generation. Evidently German industry in particular has learned its lesson: With Saenger II, an alternative from MBB is on the drawing boards that has already provided rich material for discussion within the European framework. With EARL, the abbreviation for European Advanced Rocket Launcher, Dornier as well is entering into the discussion about the sixth Ariane generation.

EARL pertains to a family of launch-vehicle systems that are to be designed both for transporting astronauts and payloads into a low orbit and also for reaching the geostationary orbit suitable for communications satellites.

The first stage consists of an apparatus with a diameter of 5.5 m that can be loaded with 160 tons of fuel. For a return following completion of the mission of the ascent, this stage is also equipped with conventional aircraft engines, turbofans, in addition to its rocket propulsion units. The rear of the reusable first stage is provided with horizontal tail unit and rudder unit surfaces, so that a controlled return flight to the launch pad is possible.

Depending on the type of use, this first stage is combined with various upper stages. A refined version of the space glider Hermes is to serve for the manned type of use—a resupply ship for the European space station. Its payload capacity of about 5.3 tons is rated higher than that for the now agreed-to Hermes of the first generation.

If satellites are to be brought into geostationary orbit or components for platforms are to be brought into low orbit without astronauts needing to be present, the second stage is to be designed as an expendable component. The unmanned cargo version for low orbits can carry 18 tons of payload capacity, and the satellite carrier for the geostationary orbit can carry 7.1 tons.



EARL Provides for Three Different Versions: Manned and Unmanned

But that is not all. Through combinations with various upper stages, scientific missions are possible even to other planets.

12114

Development, Operation of Transsonic, Cryogenic Wind Tunnels at FRG's DFVLR

Timetable for Pan-European Transsonic Wind Tunnel Development

36980178a Cologne DFVLR NACHRICHTEN in German Nov 87 pp 32-34

[Article by Dieter Schimanski and Dietrich Vennemann of ETW Project Group: "International Cooperation in the European Transonic Wind Tunnel (ETW) in Cologne-Porz"]

[Excerpts] On 12 September 1985, the governments of the Federal Republic of Germany, France, Great Britain, and the Netherlands decided to continue plans for the European Transonic Wind Tunnel (ETW). After extensive preliminary study and lengthy discussion, the draft plan had been drawn up, and the parties involved had agreed upon the site for this important large-scale testing facility: the DFVLR research center in Cologne-Porz. At the same time, the steering committee agreed on the creation of an ETW project group in Cologne-Porz and commissioned this group, under the leadership of project director K.J. Fergusson, to examine the existing draft proposal, to prepare the bid documents and to draw up a new cost estimate.

With the ETW, Europe will for the first time have a wind tunnel in which the entire range of velocity, up to the cruising speed of large civilian aircraft, can be fully simulated on geometrically similar models, meaning that the model experiment takes place at the Reynolds number for a large scale. Compared to standard wind tunnels, Reynolds numbers that are approximately five times larger are achieved using cryogenics. Cooling the flow medium in the wind tunnel, which increases density and lowers viscosity, thus having the desired effect on the Reynolds number, has already been applied successfully in several smaller facilities. The United States has a cryogenic wind tunnel for transonic velocities, the National Transonic Facility (NTF), which is not accessible to Europeans for commercial and industrial projects. As of a short time ago, the only major facility in Europe is the Cologne Cryogenic Tunnel (KKK) at DFVLR in Cologne-Porz, a subsonic wind tunnel that is of great importance as a precursor to the ETW.

In order to cool down to 90 K (-183xC), liquid nitrogen is injected into the flowing gas. In order for the pressure in the wind tunnel conduit to remain constant, a volume of gas corresponding to the injected volume of liquid must be released; in order to keep energy consumption here at a minimum, the tunnel conduits are insulated on the inside.

In designing the overall facility, particular value was placed on performance, quality and economic feasibility so that experiment costs at a high level of productivity would remain low. Flow quality, control performance, model management and data processing are the critical parameters of the ETW draft design. They demand particular attention during the detailed construction of the tunnel components, in order to ensure the performance level specified in Figure 2. Productivity is defined as 5,000 polars a year. One polar means a series of measurements with a varying measurement parameter; 10 polars constitute an average measurement of around 20 minutes that on the average is carried out three times per measurement day. In order to achieve 5,000 polars a year, especially high value was placed on a precise definition of the possible course of measurement and the associated model management (change of model configuration, heating and cooling of the measurement assembly, transport to the respective model reconstruction area). By evaluating two complex examples of future measurement programs, it was possible to precisely define the course of measurement and determine typical measurement ranges.

Optimization of these courses of measurement and the associated model management with the goal of minimizing operating costs resulted in an unconventional wind tunnel design. Using a "container operation," unique to this design, a change of model configuration between two measurements is achieved by transporting the entire measurement assembly, including the upper speed course wall, the model support, the adjustment sector and its bearing, the tunnel conduit pressure door and an instrument chamber (all together called the "model support") using a "container crane" to one of the three adjacent model reconstruction areas and then lowering it there. The injection of nitrogen gas at a desired new

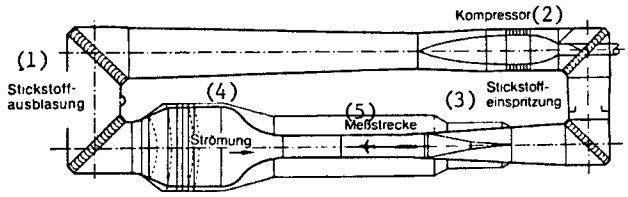


FIGURE 2. Wind Tunnel (Working section dimensions 2.4 m x 2.0 m, Mach range 0.15-1.3, working pressure 1.25-4.5 bar, working temperature 90-313K, required power 50 MW, productivity 5000 polars/year.

Key:
1. Nitrogen exhaust
2. Blower
3. Nitrogen injection
4. Flow
5. Working section

temperature makes it possible to change the temperature of the entire model support. The area located directly next to the tunnel has additional equipment that makes it possible to temper only the model and to work on the model at normal ambient temperatures. This entire building complex, including the transport hall located above the model reconstruction areas, is filled with nitrogen gas and is flushed with normal air only during maintenance work. The advantage of this is that during normal operation all moisture is kept away from the working section, and thus away from the model as well. Even very small quantities of ice particles in the tunnel circuit could result in significant measurement error. In order to minimize the costly and time-consuming change of temperature in the model reconstruction areas for every change in model configuration, a protective suit design is being studied. This should make it possible to perform light maintenance work in the wind tunnel without having to warm up the entire tunnel and fill it with normal air.

The wind tunnel model is installed on the model support under normal ambient conditions. To this end, three model equipment rooms operated with normal air are planned in the conventional part of the building. A transfer canal connects the two areas. Figure 3 shows a cross-section of the building with a layout of the entire ETW facility, in which it can be seen that an expansion of the conventional building complex is planned for later operation.

For the time being, only two of the four originally planned model supports are being built. Customer demand during the operational phase will affect the construction of other model supports.

The working section is depicted in Figure 4. The model support, which is to be elevated, is labelled as such. The working section itself consists of four slotted walls. Positioned ahead of the working section is the variable nozzle with a contraction ratio of 1:12. Behind the working section is an adjustable diffuser that is operated in the high subsonic range. The adjacent high-speed diffuser completes the working section auxiliaries that are built into the insulated tunnel conduit. These components, which are burdened by the high speeds, are only partially or not at all insulated, and must be tempered for every temperature change in the tunnel. The overall tunnel conduit is designed as a pressure conduit, is made of austenitic steel, and is protected from low temperatures by a layer of insulation around 20 cm thick. A two-stage blower provides the necessary kinetic energy, and is connected to an adjustable synchronous motor with around 50 MW power by way of a shaft running to the outside.

The necessary quantity of liquid nitrogen (75,000 tons per year) is provided for by a nitrogen condensation facility built directly next to the ETW. Nitrogen is injected in the joint pipe positioned ahead of the blower. The nitrogen exhaust is located on the opposite side, ahead of the suppressing chamber. A 50 meter-high chimney with an active air supply will ensure that the released nitrogen is adequately mixed with the ambient air.

The design plan for the ETW is being tested in existing experimental facilities. At the Dutch NLR national aerospace laboratory in Amsterdam, a pilot tunnel reduced at a scale of 1:8.8 is being operated by the ETW project group in order to examine the aerodynamic performance level. In Cologne-Porz, there is a model of the ETW working section (Test Rig) with which the quality of flow is to be determined. A cryogenics program has been set up for general support in developing wind tunnel measuring technology at low temperatures.

According to the project schedule, work on the detail draft plan will be completed in May 1988. The subsequent invitation to tenders marks the beginning of the construction phase, which will continue until the end of 1992. This will be followed by startup of operations and

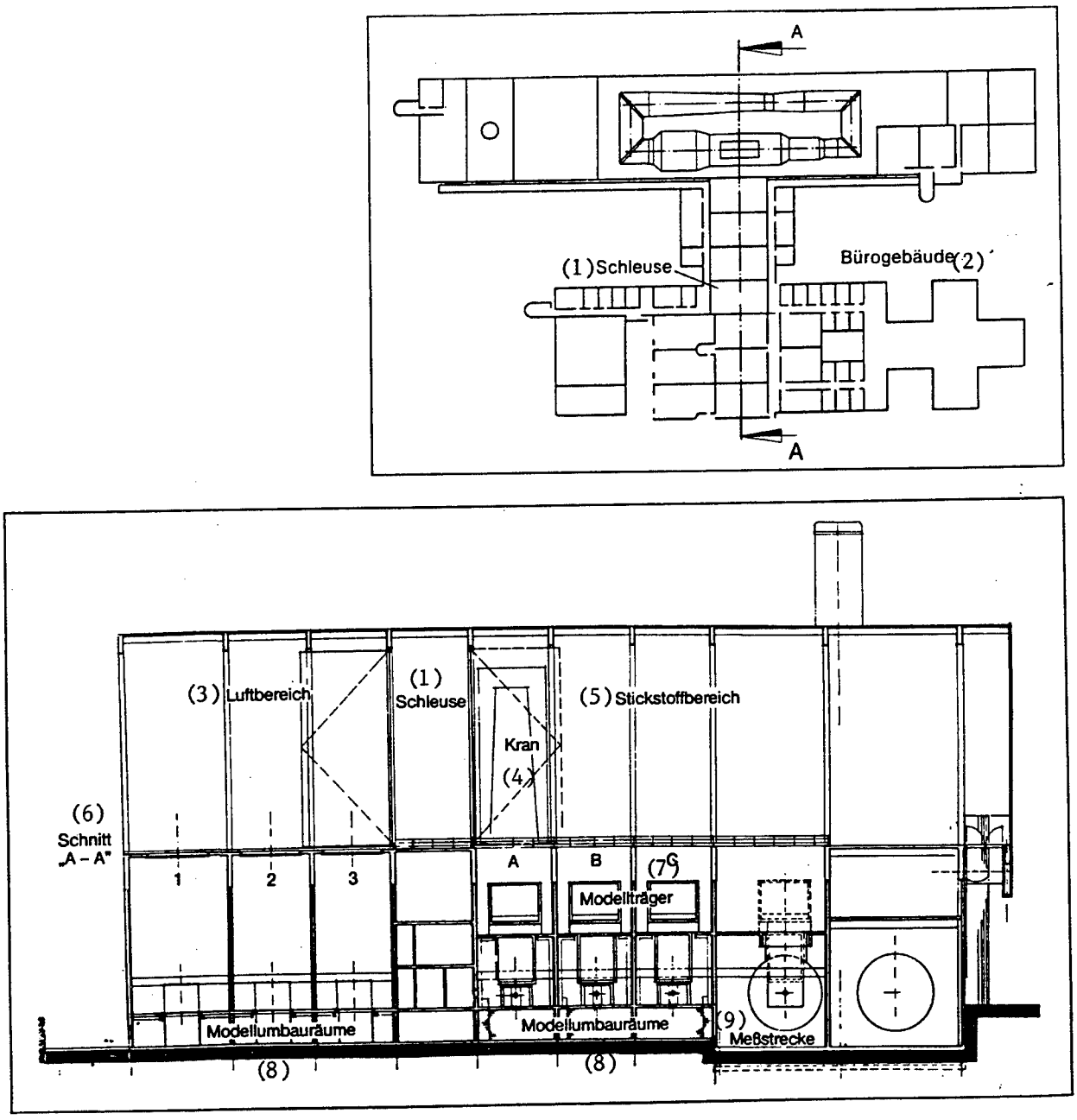


FIGURE 3. Building Cross-Section and Layout of Entire ETW Facility

Key:
1. Transfer canal
2. Office building
3. Air range
4. Crane
5. Nitrogen range
6. Section "A-A"
7. Model support
8. Model reconstruction areas
9. Working section

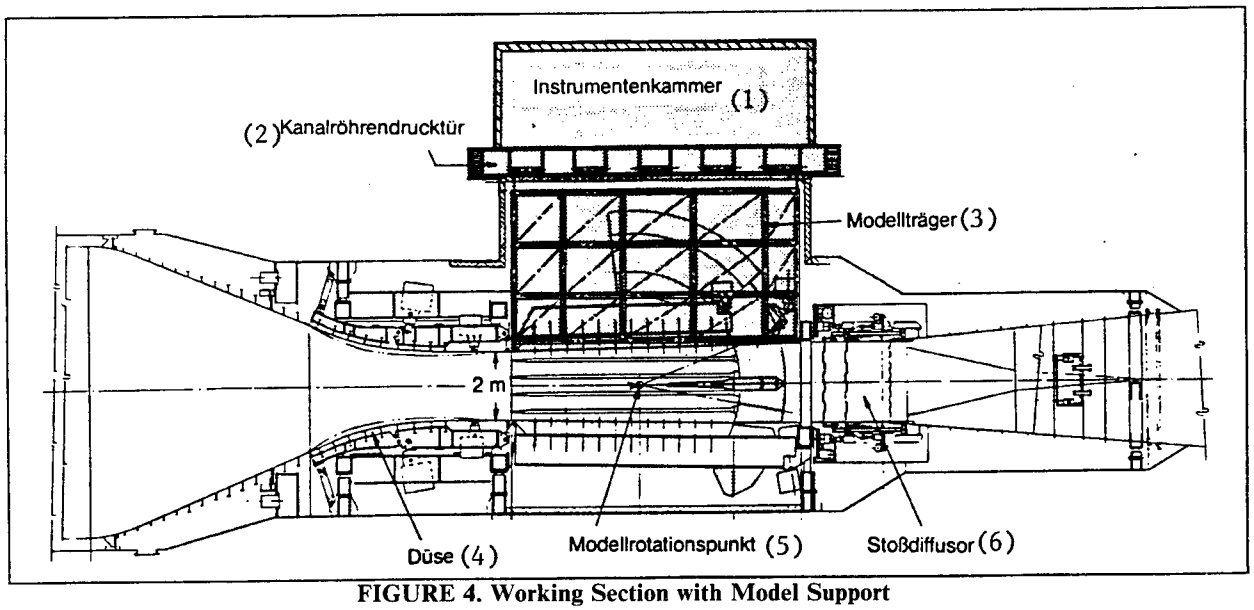


FIGURE 4. Working Section with Model Support

Key:
1. Instrument chamber
2. Tunnel conduit pressure door
3. Model support
4. Nozzle
5. Model rotation point
6. Shock diffuser

calibration of the wind tunnel, after which there will be a thorough test run during which the facility will have to demonstrate its high quality. As early as in June 1994, the ETW should be available for the first project measurements by the European aviation industry, although it will also be accessible to other clients.

In the government agreement noted at the outset concerning implementation of the detailed draft, management and supervision of the project were entrusted to a steering committee on which the four governments involved and the four national aviation research agencies are represented. The steering committee is advised by other specialists from the research institutions and by people from the ranks of future users. Planning of and control over the project is in the hands of the ETW project group, which currently comprises more than 20 specialists, almost all engineers and technicians from the various specialized fields, from the nations involved. The ETW project group is supported by DFVLR in many ways. Additional, specialized know-how is provided by other advisors. The project group employs an industrial architect who is drawing up the tasks for the detailed draft plan, in conjunction with an American engineering firm and a German architect. In organizational terms, future contractors will be looked after by the industrial architect during the construction phase. At this stage, the project will be converted into a legally autonomous limited liability company (GmbH according to German law), the corporate members of which will be the research institutes of the four countries involved. The present steering committee will become the board of directors of the GmbH, and around 40 people will be added to the project group for the construction phase.

Construction costs, including startup and calibration, are currently estimated at around DM 560 million. This money is to be raised according to the following financing key: FRG 38 percent, France 28 percent, Great Britain 28 percent, the Netherlands 6 percent. In addition, the West German government has assumed responsibility for providing a construction site and financing the necessary infrastructure (electricity, water, gas, etc.). The chosen site is located in the Cologne area, just south of the far limit of the DFVLR grounds.

12271

Cologne Cryogenic Tunnel as Demonstrator

36980178b Cologne DFVLR NACHRICHTEN in German Nov 87 pp 38-39

[Article by Guenter Viehweger of DFVLR Wind Tunnel Division, Cologne-Porz: "Cologne Cryogenic Tunnel"]

[Excerpts] The Cologne Cryogenic Tunnel (KKK) came about after 5 years of reconstruction on a conventional subsonic tunnel (Figure 2). The purpose of modifying the existing facility and installing a number of additional components was to make it possible in the future to

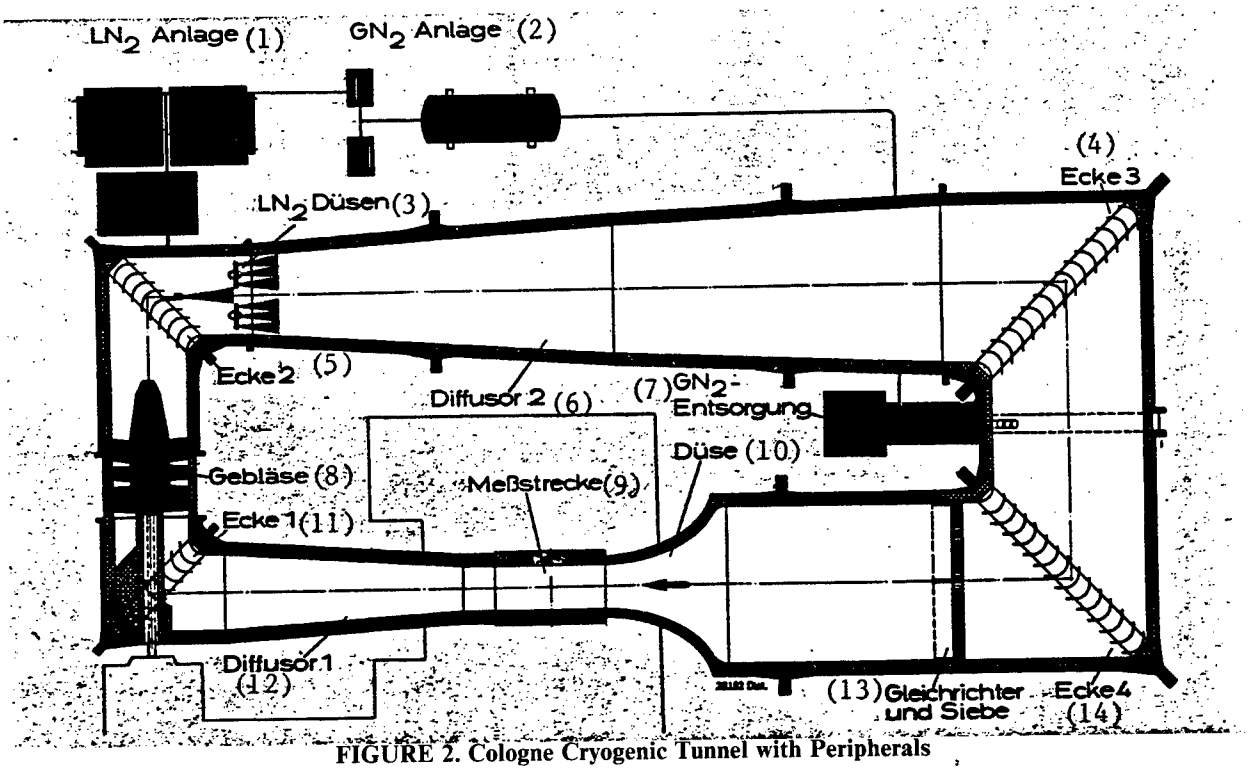


FIGURE 2. Cologne Cryogenic Tunnel with Peripherals

Key:
1. LN_2 facility
2. GN_2 facility
3. LN_2 nozzles
4. Corner 3
5. Corner 2
6. Diffuser 2
7. GN_2 waste disposal
8. Blower
9. Working section
10. Nozzle
11. Corner 1
12. Diffuser 1
13. Rectifier and sifters
14. Corner 4

operate the tunnel at a temperature range extending from ambient conditions to -173xC. By lowering the temperature by 200xC, it is possible to increase the Reynolds number by a factor of 5.5. Compared to a conventional wind tunnel, this tunnel exhibits the following characteristic differences:

—Gaseous nitrogen is used as the test gas.

—A transfer canal and a model climatic room are installed under the working section (Figure 4).

—Injection device for liquid nitrogen in order to control temperature, with precise metering facilities.

—Waste disposal facilities for gaseous nitrogen, controlled by pressure in the wind tunnel.

—Costly thermal insulation, to protect the concrete conduits from low temperatures.

There is already an extensive measurement program for the period beginning in 1988; it has for the most part been attuned to the German aviation industry, the U.S. Air Force in Tullahoma and NASA in Langley. Further calibration measurements in the individual tunnel sections remain to be done this year.

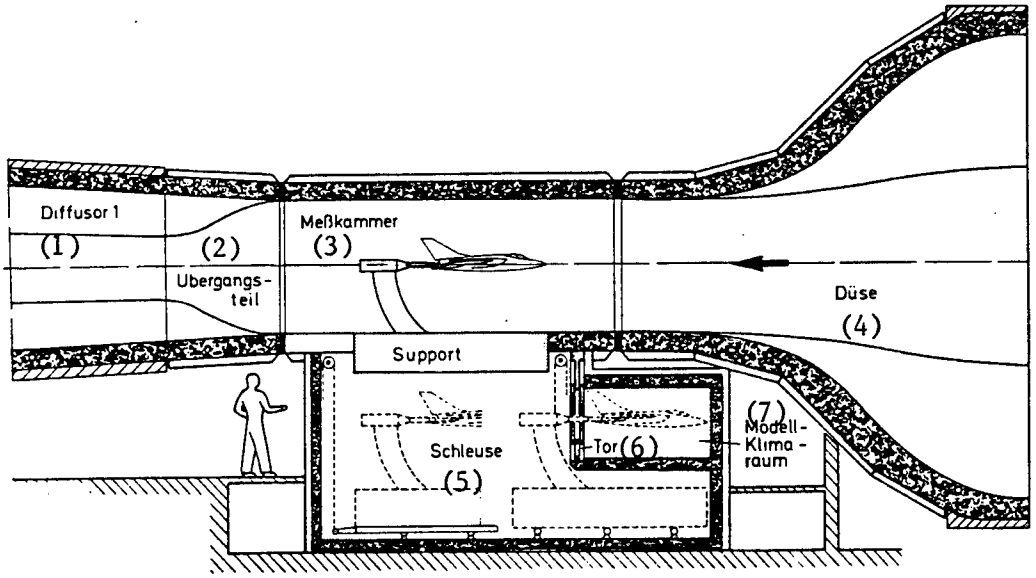


FIGURE 4. Working Section Area of the Cologne Cryogenic Tunnel

Key:
1. Diffuser 1
2. Transition section
3. Measurement chamber
4. Nozzle
5. Transfer canal
6. Gate
7. Model climatic room

12271

Currently Operating Wind Tunnels at FRG's DFVLR

36980178c Cologne DFVLR NACHRICHTEN in German Nov 87 p 36

[Article by Franz Maurer of DFVLR Wind Tunnel Division, Cologne- Porz: "Tasks of the Supersonic and Hypersonic Wind Tunnels in Cologne- Porz"]

[Excerpts] The super- and hypersonic wind tunnels at the Cologne- Porz research center were designed for the areas of aviation, missile and rocket aerodynamics, as well as for special problems of space and reentry aerodynamics. The following facilities are currently in operation:

—Trisonic Wind Tunnel (TMK), working section 60 x 60 cm, Mach number 0.5 to 4.5, with special transonic working sections and flexible variable nozzle.

—Supersonic Wind Tunnel (HMK), working section 30 x 30 cm, Mach 0.4 to 0.9 and fixed nozzles Mach 1.5 to 4.5.

—Vertical Free-Jet Working Section (VMK), working section diameter 34 cm, with Mach 0.4 to 0.9 and various nozzles in the supersonic range up to Mach 3.2.

—Hypersonic Wind Tunnel (H2K), effective nozzle diameter 60 cm for Mach 6; 8.7; 11.2 and 36 cm for Mach 4.8.

—Calibration Tunnel (EMK), alternatively the ETW Test Rig and a test stand for mountings.

The arc-heated wind tunnels (plasma wind tunnels) are not in operation; these tunnels are especially well-suited for studying thermal protection systems on hypersonic transporters or reentry craft.

12271

British Airways Cites High Fuel Consumption of Airbus A320

36980174a Frankfurt/Main FRANKFURTER ALLGEMEINE ZEITUNG in German 2 Feb 88 p 15

[Article by J.Rh.: "The Airbus is too Expensive to Operate: British Airways Is Talking about 'Damages'"]

[Text] London, 1 Feb.—A spokesman for the European Airbus Consortium in Toulouse has confirmed that the A320 medium range aircraft has not as yet exactly

fulfilled expectations for fuel consumption. But he characterized this deficiency as minimal. According to his data, the two CFM propulsion units consume about 8% more fuel than originally planned. But since fuel only constitutes one fourth the direct operating costs, this additional expense has little significance. The deficiency will be corrected in later machine deliveries.

He also confirmed that the tare weight of the 150 passenger plane is also higher than planned. Airbus Consortium engineers chose somewhat heavier dimensions in the interests of safety. Insofar as the plane is going to be used only or primarily inside Europe, which is the case with British Airways, this does not decrease its payload any because it is also capable of long-range flights. The Chairman of the Board of Directors of British Airways PLC, Lord King, had complained over the weekend that the A320 consumes up to 9 percent more fuel than planned. According to his representation, a series of factors affect its performance: higher tare weight than planned, greater wind resistance, and higher specific fuel consumption by the propulsion systems. The airline will be receiving its first planes of this model next week. Until now British Airways has not had any Airbus planes in service. But since they have taken over British Caledonian Airways, they must honor their obligation to purchase ten A320s.

Lord King has already talked about the company, which was recently privatized, demanding damages for the cited deficiencies. In London the word is that this could possibly influence the decision on the A340 long-range aircraft that is competing with the McDonnell Douglas MD11, for instance, as a replacement for the old Lockheed Tristar.

13127

BIOTECHNOLOGY

French Analysis of FRG Biosensor R&D

3698A056 Bonn RAPPORT D'AMBASSADE—INFORMATION SCIENTIFIQUE in French 29 Aug 86 pp 1-13

[Report edited by Mr Baverez and published by the French Embassy in Bonn, FRG: "Biosensors in the FRG"]

[Text]

I. Introduction—General Remarks

Biosensor research falls into the category of bioelectronics, a fairly recent branch of science which combines microelectronics and biochemistry. Most accurately, the generic term "biosensors" covers sensors whose task is to detect biological or biochemical substances using active components of a biochemical (enzyme) or biological (microbe, antibody) nature which produce physical effects or the appearance of quantifiable substances.

Sensors can be grouped into three major categories: enzyme sensors, microbial sensors, and antigen/antibody sensors.

1. Enzyme Sensors

a) enzyme electrodes apply to the following principles:

—potentiometric analysis;

—amperometry;

—polarography;

—conductimetry

b) field-effect transistors (ENFET-type)

c) thermistors

d) optoelectronic sensors

e) piezoelectric crystals

2. Microbial sensors

a) microbial electrodes

b) field-effect transistors (still at the research stage)

3. Antigen/Antibody Sensors

a) field-effect transistors

b) thermistors (TELISA)

II. Areas of Application

1. The Medical Field

Medicine is one of the major areas of biosensor application. Biosensors are used in particular to analyze body tissue and fluids for diagnosis or for monitoring diseased organs. Although current achievements in this area do not yet satisfy all the demands of the medical sector, the presence of the following substances in blood can now be measured: ammonia, galactose, glucose, sitosterol.

Moreover, research is currently under way into the development of "biochips" capable of replacing deficient neurons as part of the treatment of ailments such as paralysis or loss of vision. This research, however, is far from completion.

2. Process Control

Biosensors have been developed for use in monitoring and even controlling biological or biochemical processes. Compared with traditional measuring methods, biosensors have three substantial advantages: speed, accuracy, and cost.

Biosensors, which are used increasingly in the agrofood industry, make it possible today to detect the following substances: alcohol, ammonia, ethanol, ethyl alcohol, cholesterol, glucose, glutamic acids, lactate, nitrates, nitrites, penicillin, pyruvates.

3. Environmental Protection

Chemical or ion-selective sensors can easily be used to detect simple gases, but they also make it possible to disclose substances in water and air which until now have been difficult to detect. To find a specific toxic substance, one must use a suitable enzyme.

In the field of environmental protection the development of biosensors is in its infancy, with Japan slightly ahead of its competitors. However, it is already possible to measure the presence of ammonia and organic substances in water (by measuring microbial oxygen demand) and of carbon monoxide and other toxins in the air. This could lead to military applications with the detection of certain gases such as malathion.

III. The State of Research in the FRG

Biosensors research in the FRG dates back some 15 years. With rare exceptions, operational systems of analysis have not yet been produced. The current state of knowledge should, however, speed the arrival of such systems on the technology market, particularly in the field of chemistry, medicine, and environmental protection.

The following list surveys the leading biosensor research groups in the FRG, indicating their main research topics in this field.

A. Universities

1. Technical University of Munich

Chair of General Chemistry and Biochemistry

5-8050 Freising-Weihenstephan

Phone: (08161) 71-253

Prof H.L. Schmidt

Main areas of research:

—determination of the kinetic effect of isotopes in reactions using enzymes as catalysts, with a view to studying variation in the natural frequencies of isotopes found in bioelements;

—spectrometric analysis of titration systems;

—manufacture of amino acids using organochemical and biochemical reactions;

—application of tagged bonds to clinical diagnostic tests used to locate metabolic defects;

—development of enzyme electrodes and fluid injection systems for clinicochemical analysis and process control;

—kinetic analysis of photoreactions and reactions in the dark;

—development of electrodes for use in the electrocatalytic reduction and oxidation of coenzymes.

Professor Schmidt's team was given a DM297,800 subsidy for the 1983-85 period by the GMFT [Federal Ministry for Research and Technology] to study the continuous monitoring of enzyme and microbe processes using enzyme electrodes.

2. University of Ulm

Faculty of Natural Sciences and Mathematics

Analytical Chemistry Section

Postfach 4006 D-7900

Ulm, Donau

Phone: (0731) 176-2181

Prof K. Ballschmiter

Prof K. Cammann

Main areas of research:

—analysis of organohalogenated compounds: trace analysis processes;

—biotic and abiotic degradation;

—trace analysis on polycyclic aromatic compounds;

—electrochemical chromatographic detection;

—specific plasma emission during microwave excitation;

—development of ion-selective electrodes;

—construction of miniaturized glucosensors using pH-sensitive field-effect transistors;

—development of immune electrodes (antigen/antibody reaction).

3. Technische Hochschule of Aachen

School of Mathematics and Biology

Templergraben 55

D-5100 Aachen

Phone: (0241) 80-7055

Prof G. Heiland

Prof W. Sander

Main areas of research:

—metal/semiconductor contact;

—gas adsorption on semiconductor surfaces;

—organo-anorganic semiconductors;

—gas sensors (especially ethanol and acetic acid).

4. Technical University of Braunschweig

Institute of Technochemistry

Postfach 33 29

D-3300 Braunschweig

Phone: (0531) 391-5360

Prof A. Lowe

Main areas of research:

—catalysis using polymeric sulfonic acids and Lewis acids;

—heterogeneous biocatalysis: fixing enzymes and cell on biological and synthetic polymers;

—heterogenous catalysis: macrokinetics, including radioactive decay kinetics, of complex reactions;

—theory and modeling of catalytic reactors;

—experiments with semiconductor-based gas sensors for measuring ethanol, H_2, CH_4, and NH_3.

5. University of Giessen

Institute of Veterinary Biochemistry and Endocrinology

Frankfurterstrasse 100

D-6300 Giessen

Phone: (0641) 702-4840

Prof M. Sernetz

Main areas of research:

—kinetics of structured systems (project supported by the DFG [German Research Association];

—controlling the metabolism of glucides and purines by regulating the activity of pyruvate kinase (DFG);

—development of a quantitative and qualitative test on isoenzymes of pyruvate kinase in tissues and blood for early detection of carcinogenic substances (BMFT);

—development of analytical reactors using immobilized enzymes (e.g., measurement of the number of fluorogenic substrates);

—fluorometric analysis of changes in carrier matrices;

—development of dispersive measuring processes and the corresponding measuring probes;

—development of a pulsed fluorometric probe for the continuous measurement of specific dispersion in a bioreactor. This probe is also used to analyze the properties of carrier matrices (gels, membranes).

Professor Sernetz's team long-term objective is the development of biosensors based on immobilized enzymes, specifically glucose, galactose, and oxygen sensors, with potential applications in the control of bioreactors or medical diagnosis.

6. University of Muenster

Institute of Microbiology

Correnstrasse 3

D-440 Muenster

Phone: (0251) 83-3398

Prof H.D. Rehm

Main areas of research:

—multiple bond reactions with immobilized micro-organisms;

—development of immobilized micro-organisms for degrading undesirable substances (e.g., phenols, aromatics, alkanes).

7. University of Marburg

School of Medicine

Institute of Applied Physiology

Karl-von-Frisch-strasse

D-3550 Marburg

Phone: (06421) 28-5030

Dr J.G. Schindler

Main areas of research:

—electrophysiology of the skin;

—development of ion-selective electrodes for measuring Na^+, K^+, and Ca^{2+};

—development of sensors for various physicochemical parameters.

8. University of Hannover

School of Chemistry

Institute of Technochemistry

Callinstrasse 3

D-3000 Hannover

Phone: (0511) 762-2253

Prof Schugerl

Biotechnology research, particularly high-temperatures on reactions.

9. University of Erlangen-Nuremberg

School of Medicine

Institute of Physiology and Cardiology

Waldstrasse 6

D-8520 Erlangen

Phone: (09131) 85-2300

Prof M. Kessler

Main areas of research:

—administration of insulin for diabetics using blood biosensors; a U.S. license for this process was purchased in June 1986;

—quantitative photometry of cell tissues;

—development of H_2, O_2, CO_2 electrodes.

B. Institutes of the Max Planck Society

The institutes of the Max Planck Society concentrate on basic research, a field in which they occupy a prestigious position in the FRG. Although their research themes rarely concern biosensors as such, it is nevertheless worthwhile to mention the work of certain institutes which contribute to the development of knowledge in this field.

1. Max Planck Biochemistry Institute

Department of Biochemical Methods

Am Klopferspitz 18a

D-8033 Martinsried bei Muenchen

Phone: (089) 85-781

Prof K. Hannig

Main areas of research:

—electrophoretic separation processes;

—continuous isoelectric concentration using deflection electrophoresis.

2. Max Planck Biophysics Institute

Kennedyallee 70

D-6000 Frankfurt a.M. 70

Phone: (069) 63-031

Prof H. Passow

Membrane research.

3. Max Planck Neurological Research Institute

Department of Experimental Neurology

Ostmerheimerstrasse 200

D-5000 Koeln 91

Phone: (0221) 89-061

Prof K.A. Hossmann

Development and application of measuring processes for the quantitative representation of hemodynamic and metabolic parameters in animal experiments.

4. Max Planck Physiological and Clinical Research Institute

Parkstrasse 1

D-6350 Bad Nauheim

Phone: (06032) 60-15

Prof E. Simon

Prof E. Dodt

Main areas of research:

—physiology of body temperature regulation;

—systems for regulating blood circulation, respiration, and water and salt content;

—electrophysiological ophthalmology.

5. Max Planck Biophysical Chemistry Institute

Am Fassberg

D-3400 Goettingen-Nikolausberg

Phone: (0551) 20-11

Department of Biochemical Kinetics

Prof M. Eigen

Research into the mechanisms of inorganic, organic, and biochemical reactions, including measurement of the speed of the elementary stages.

Department of Neurochemistry

Prof V.P. Whittaker

Study of specific synaptic components using biochemical, biophysical, and immunological methods.

Department of Membrane Biophysics

Prof H. Strehlow

Biological membrane control and regulation mechanisms.

The Association of Major Research Centers (AGF) unites 13 public institutes to carry out research that requires interdisciplinary cooperation and the concentration of considerable equipment and personnel. Ninety percent of their funding comes from the federal government and 10 percent from the Laender where they are located.

Two members of the AGF are researching biosensors.

1. Biotechnology Research Society (GBF)

Mascheroder Weg 1

D-3300 Braunschweig-Stoeckheim

Phone: (0531) 6181-0

Prof K. Schuegerl

Dr E. Lustig

Main areas of research:

—process development (e.g., continuous fermentation of acetone and butanol);

—development of online methods of process analysis and regulation, particularly, a mass spectrometer for measuring ethanol concentration and an automatic system for analyzing glucose, NH_4, and phosphate concentrations.

2. Juelich Nuclear Research Center (KFA)

Institute of Biotechnology [IBT]

Postfach 1913

D-5170 Juelich 1

Phone: (02461) 610

Prof H. Sahm

Prof C. Wandrey

Prof C.-J. Soeder

Main areas of research:

—degradation of cellulose and hemicellulose;

—biotechnological production of "L" amino acids from synthetic amino acids;

—water treatment using anaerobic microbes;

—membrane reactor for enzymes;

—enzyme catalysis;

—biocatalytic action of microorganisms and isolated enzymes;

—biological elimination of nitrates;

—biochemical process technology.

The Juelich KFA is one of the bodies responsible for implementing the Federal Ministry for Research and Technology's biotechnology program. Specifically, its task is to supervise the "Biotechnological Process Development Subprogram" which includes, among other items, the development of substance- and process-monitoring sensors. The table reproduced below shows KFA's programs.

IV. Institutes of the Fraunhofer Society

The Fraunhofer Society is the largest institution for contract research in the FRG. It receives up to 25 percent of its funds from public sources.

Among the Society's 38 institutes, only one works with biotechnological processes:

Fraunhofer Institute for Research into Biological Interfaces and Processes (IGB)

Nobelstrasse 12

D-7000 Stuttgart 80

Phone: (0711) 6868-01

Prof H. Chmiel

Dr H. Strathmann

Main areas of research:

—interface phenomena: impregnation, capillarity, surface modification;

—development of processes for the detoxification of blood and diagnosis and therapy of cardiovascular diseases;

—development of membranes for separation operations such as gas separation, pervaporation, and electrodialysis;

—application of enzyme technologies to the medical and agrofood fields.

Table. Biotechnological Subprograms Funded by the BMFT and Conducted by the Juelich KFA

Programs	Partners
I - Biotechnology and Agrofood	
I.01: Biotechnological production of animal feed and food products	- Firms - University institutes - Federal Food Research Institute - Federal Agricultural Research Institute
I.02: Medical and physiological evaluation of animal feed and food products	- BMJFG (Federal Ministry of Youth, Family, and Health) - BML (Federal Ministry of Food Agriculture, and Forestry)
II - Pollution and Environment	
II.01: Natural antipollutants	- Chemical industry firms - University institutes - Max Planck institutes
II.02: Action of specific insect viruses in combatting pollution	- Industry - University institutes - Federal Agricultural Research Institute - IBT of the Juelich KFA
III - Natural Substances and Simple Pharmaceutical Elements From Cell Cultures	
III.01: Pharmacologically active substances from vegetable cell cultures	- Industry - National Council of Research and Development, Jerusalem (for part of the program)
III.02: Production of pharmaceutical products and vaccines from animal cell cultures	- Industry - University institutes - Federal Research Institute for Virus Diseases in Animals

Table. Biotechnological Subprograms Funded by the BMFT and Conducted by the Juelich KFA

Programs	Partners
III.03: Improvement of useful plants using cell culture techniques	- BML - University institutes - Max Planck institutes - Industry
IV - Production and Recovery of Raw Materials	
IV.01: Biological processes for the development of new substances from vegetable waste	- Industry - Federal Research Institute on the Processing of Potatoes and and Cereals (Detmold) - IBT of the Juelich KFA
IV.02: Fermentation processes	- Industry - Institute of Fermentation and Biotechnology
IV.03: Extraction of metals using biological processes	- GBF - Federal Institute of Geological and Mineral Sciences - BMW (Federal Ministry for Economics)
Development of Biotechnological Processes	
V.01: Development and testing of bioreactors for cell systems	- Firms from the chemical and mechanical engineering sectors - University institutes - GBF (Departments: Biotechnikum [technical school], Biotechnology)
V.02: Development and testing of bioreactors for non-cell systems	- Industry - University institutes - GBF (Department of Enzyme Technology) - IBT of the Juelich KFA
V.03: Measurement, control, and regulation, sterilization, and processing techniques	- Industry - University institutes - GBF
VI - Basic Research Into Biotechnological Processes	
VI.01: Research into the development and evaluation of new biological techniques	- University institutes - GBF (genetic technology) - Max Planck institutes - Fraunhofer institutes
VI.02: Collection of biotechnologically important cultures	- GBF (Department: DSM [German Microorganism Collection]

25065/06662

COMPUTERS

FRG Expects Growth in Demand for Information Technologies

3698m169 Bonn BMFT JOURNAL in German
No 6, Dec 87 p 2

[Excerpts] Information science is increasingly becoming a key technology. Its significance for the development of science and technology itself, for society in general, and for overall economic success is growing rapidly.

This was the opinion expressed by FRG Research Minister Dr Heinz Riesenhuber at the opening of the Computer Technology Society's international congress at the Systems'87 trade fair in Munich.

The FRG's success as an industrial nation over the coming years is largely dependent on the extent to which it can further develop information technology. It is not only a decisive economic and competitive factor but also important in promoting growth.

Last year's hardware and software production of office information and communication industry amounted to almost DM50 billion. In the office and information technology sector alone the workforce has risen by 8.7 percent to 94,000. This means that including communication technology and service industries, there are almost 300,000 people working in this sector.

This growth trend in the information technology sector will continue, and will provide an important impetus to the economy. An overall annual growth rate from 12 to 14 percent is expected for the international information processing market by 1995. From a worldwide sales volume of over $200 billion, 80 percent will be attributed to U.S. firms. All European computer manufacturers account for only about 8 percent of the world market.

The fear of the U.S. and Japanese technology myth has been replaced by faith in the future. The Institute for the German Economy, for example, has affirmed that the FRG has caught up in the high-tech sector. Overall the FRG occupies the third place after the United States and Japan. Riesenhuber is particularly concerned about the question of research personnel. The research bottleneck in the FRG is due not so much to a lack of capital but rather to a lack of qualified personnel. "We are suffering from a quantitative rather than a qualitative deficit," the minister explained. The planned research center for artificial intelligence in Kaiserslautern/Saarbruecken is expected to bring about an improvement in the situation.

08706

LASERS, SENSORS, OPTICS

French Military Installs Most Powerful Laser in Europe

3698A049 Paris L'USINE NOUVELLE in French
5 Nov 87 p 58

[Article by Michel Defaux: "The Largest Industrial Laser in Europe"; first paragraph is L'USINE NOUVELLE introduction]

[Text] With a 25-kW laser, ETCA will test the capabilities of high power lasers for welding, cutting, and surface treatment.

With the arrival of the 25-kW CO_2 laser built by the American firm United Technologies, ETCA (Central Technical Establishment for Armament) in Arcueil now occupies first place in Europe. This device, which cost about Fr 6 million, has been added to the already existing 1-kW and 5-kW CO_2 lasers. All the beams are pinpointed, at will, to five work stations. This novel arrangement allows several teams to have simultaneous access to the three laser sources for different tasks.

In this way ETCA is pursuing its research into the evaluation of laser performances and their role in armaments production for cutting, welding, and surface treatment. Alain Quenzer, technical assistant to the director and the person behind the project, emphasizes that "despite our long-standing experience with 5-kW lasers, it is not yet known in Europe what can be done with a 25-kw laser, or whether it would be advantageous to go to even more powerful lasers."

Even before the results of the initial tests are known, significant gains in productivity are expected. For example, with a 5-kW CO_2 laser, cuts 30 to 40 mm deep were made in armor steel with one oxygen supply. Current efforts are focused on steel thicknesses of 100 mm for cutting submarine and tank hulls.

For welding steel and titanium, joint depth would be increased from 8 mm to 20 mm. In the case of lesser thicknesses, the speed factor would be increased with the result that beads as narrow as those produced in electron beam welding could be achieved, with the tremendous advantage of not having to work in a vacuum.

In surface treatment without additional oxygen (titanium nitriding or fine-graining aluminum alloys [?affinage de grain sur alliages d'aluminium]) or with additional oxygen (cast alloy powders, buildup welding), the aim is to work more quickly on larger areas. For example, until now the prior deposit remelt rate [?refusion de depot prealable] was on the order of 1/10 cm^2 per second with the 5-kW laser. The experts expect an increase here of a factor of five.

The last application, and far from the least important as far as the military is concerned, is the simulation of the resistance of materials to laser impact. The 25 kW per cm^2 impact, comparable to values of several megawatts per square meter announced in several "Star Wars" projects, will allow the Arcueil facility to test the behavior of missiles and of their nuclear warheads in the presence of such radiation.

25050/06091

SCIENCE & TECHNOLOGY POLICY

Italian Research Ministry Allocates Funds for Company R&D

3698m135 Rome GAZZETTA UFFICIALE DELLA REPUBBLICA ITALIANA in Italian No 283, 3 Dec 87 pp 20-25

[Announcement of the Italian Ministry for the Coordination of Scientific and Technological Research on the "Admission of Research Projects to the Special Fund for Applied Research," issued in Rome on 13 November 1987]

[Excerpts] The following research projects will receive financing from the Special Fund for Applied Research under the terms of the aforementioned laws. The sizes of these awards and the related terms and conditions are specified for each project:

Mandelli 2 S.p.A., Montefredane (Avellino), large company classification.

Place of execution: north and south Italy.

Program: study and development of a prototype of a processing cell equipped with artificial intelligence (ref. 48432).

Form of financing: easy credit available at an annual interest rate established by the Treasury Minister; subsidy.

Maximum amount:

a) easy credit: 4.247 billion lire, of which 890 million lire, equal to 35 percent of the allowed costs, to be allocated to the north of Italy, and 3.375 billion lire, equal to 40 percent of the allowed costs, to be allocated to the south of Italy;

b) subsidy: 4.247 billion lire, of which 890 million lire, equal to 35 percent of the allowed costs, to be allocated to the north of Italy, and 3.375 billion lire, equal to 40 percent of the allowed costs, to be allocated to the south of Italy.

Duration: 8-year amortization period in addition to the time needed for the research; the latter is not to exceed 5 years.

Amortization: Sixteen semi-annual equal-deferred installments, inclusive of capital and interest, starting from the second due-date following the effective date of completion of the research program.

Starting date of the program: 1 January 1987.

Microsistemi s.r.l., Rome, large company classification.

Place of execution: north Italy.

Program: advanced design systems for VLSI [Very Large Scale Integration] circuits (ref. no 47308).

Form of financing: easy credit available at an annual interest rate established by the Treasury Minister; subsidy.

Maximum amount:

a) easy credit: 35 percent of the allowed costs, equal to 2.285 billion lire;

b) subsidy: 35 percent of the allowed costs, equal to 2.285 billion lire.

Duration: 8-year amortization period in addition to the time needed for the research; the latter is not to exceed 4 years and 6 months.

Amortization: Sixteen semi-annual equal-deferred installments, inclusive of capital and interest, starting from the second due-date following the effective date of completion of the research program.

Starting date of the program: 15 October 1985.

Special conditions: Guarantee from Ing Massimo Rinaldi.

Officine Galileo S.p.A., Campi Bisenzio (Florence), large company classification.

Place of execution: north Italy.

Program: new processes and plant for the production of metallized plastic films (ref. no 48719).

Form of financing: easy credit available at an annual interest rate established by the Treasury Minister; subsidy.

Maximum amount:

a) easy credit: 35 percent of the allowed costs, equal to 1.629 billion lire;

b) subsidy: 35 percent of the allowed costs, equal to 1.629 billion lire.

Duration: 8-year amortization period in addition to the time needed for the research; the latter is not to exceed 3 years and 6 months.

Amortization: Sixteen semi-annual equal-deferred installments, inclusive of capital and interest, starting from the second due-date following the effective date of completion of the research program.

Starting date of the program: 1 September 1986.

Special conditions: Guarantee from the financial company Ernesto Breda S.p.A., Milan.

08616

MATRA of France Denationalized, Forms New Alliances

Role of GEC, ERICSSON, AEG

36980186a Paris ELECTRONIQUE ACTUALITES in French 29 Jan 88 p 20

[Article: "The MATRA [Mechanics, Aviation and Traction Company] Group and its New Shareholders: Many Cooperation Agreements Considered by MATRA, GEC [General Electric Company, Great-Britain], ERICSSON, AEG [General Electric Company, FRG]"]

[Text] A veritable network of cross alliances and industrial cooperation agreements is expected to be formed in the next few months between MATRA and the three European groups that now own a share of its stable stock core, i.e. the German Daimler-Benz, the British GEC and the Swedish Wallenberg.

For MATRA, the rapprochement with these groups should result in a series of cooperation agreements and the acquisition of holdings in certain subsidiaries of its three partners.

According to MATRA, "before launching new projects or answering invitations to bid, we shall first try to agree among ourselves."

The agreements considered could involve, in particular, observation satellites, data processing, lightweight subway cars (in particular with Daimler-Benz and its AEG subsidiary), and railroad equipment in collaboration with GEC—especially for automation projects for the London subway.

Generally speaking, we should note that GEC intends to embark, with MATRA, on a wide range of joint projects, in particular in the field of cellular radiotelephones. In this field, it already seems probable that the MATRA-Ericsson agreement will also include GEC. As is known, Ericsson is controlled by Wallenberg, a new MATRA shareholder.

In the longer term, GEC is also considering a partnership with MATRA and Ericsson on public and private telephone exchanges. MATRA and its new partners are also considering cooperation agreements, especially on military electronics.

For instance, GEC sees a complementarity between its Marconi subsidiary and the MATRA defense sector.

Missile-related agreements appear to be already under consideration by MATRA, GEC and AEG. MATRA noted in particular that programs such as the Mica air-to-air missile, on which the group is now working alone, have "a natural tendency to become international in Europe." With Ericsson, they added, the Mistral ground-to-air missile could become a more ambitious weapon system.

Details on New Company, Structure

36980186a Paris LES NOTES BLEUES in French 1-7 Feb 88 section 369

[Article: "Privatization of MATRA [Mechanics, Aviation and Traction Company"]

[Excerpts] On 19 January 1988, Mr Edouard Balladur, state minister, minister of economy, finance and privatization, announced the conditions of the MATRA privatization operation.

The public sale offering started on Wednesday 20 January for only six days. It was completed on Wednesday 27 January, in the evening.

After reading the Privatization Commission's decision to set at Fr2.0 billion the minimum value of MATRA's stock, the commission's opinion concerning the selling procedure (paragraphs 5 and 9 of article 3 of the law of 6 August 1986) and the commission's opinion on the use of the procedure of sale outside the market contained in article 4 of that law, the state minister set the terms and conditions of the operation.

In compliance with paragraph 7 of article 3 of the law of 6 August 1986, the Privatization Commission also issued an opinion on these terms and conditions, stating that they were fully in compliance with its decisions and opinions.

The decisions made by the state minister are as follows:

1. Scope of the Operation

The stock of MATRA consists of 19,870,404 shares; 10,128,000, i.e. 50.97 percent of the stock, are owned by the State.

The operation involved the sale, by the State, of 9,003,716 shares; the State will temporarily retain 1,124,284 shares in reserve, in particular for ulterior free share distributions.