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West Europe Report

SCIENCE AND TECHNOLOGY

(FOUO 14/81)

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WEST EUROPE REPORT

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CONTENTS

ELECTRONICS

BRIEFS

BUBBLE MEMORIES--Bubble memories have had a decidedly turbulent history. Following Rockwell and Texas [Instruments] it is now National Semiconductor's turn to announce its withdrawal from the field, attesting to a market which is too small because of prices which are still high in comparison with competitive technologies, principally magnetic disks and semiconductor memories. Also working against bubble memories is the slow development of interface and peripheral circuits. National Semiconductor's decision directly concerns SAGEM [Company for General Applications of Electricity and Mechanics] which had executed cooperation agreements allowing it to offer a very wide range of products and peripheral circuits for "civil" applications upon the market. The SAGEM has no intention of abandoning its bubble memory technology, for aerospace and military applications, developed from the work of LETI/AEC [Electronics and Data Processing Technology Laboratory, Grenoble/Atomic Energy Commission]; moreover it is installing large production facilities at Eragny. Nevertheless the National Semiconductor decision will have an effect because in all probability it is going to compel SAGEM to redefine its commercial policy as far as civil applications are concerned. [Text] [Paris AIR & COSMOS in French 12 Sep 81 p 31] [COPYRIGHT: A.&C. 1980] 11706

CSO: 3102/12

ENERGY

STATUS OF COAL-CONVERSION PROJECTS AT RUHRKOHLE AG

Hamburg ERDOEL & KOHLE-ERDGAS-PETROCHEMIE in German Sep 81 pp 379-386

[Article by Josef Langhoff, Rainer Duerrfeld, and Eckard Wolowski: "New Technologies for Hard Coal Refining"]

[Text] [English-language summary] The successful operation of pilot and demonstration plants, followed by preliminary project estimates for industrial scale plants form the basis of commercialization of new technologies for coal processing. From a technical point of view large scale plants can be justified even today. Depending upon the size of the plant and the time requirements for official approval, it takes four to ten years to put such a plant into operation. Considering the economics, however, operation of such plants using domestic coal--apart from exceptional cases--is not feasible. The financing of these projects is, therefore, possible only with the support of public resources. Assuming that the present relaxed situation of oil and gas supply is only temporary, and supply bottlenecks and price problems have to be reckoned with in course of time, financial support of such projects appear justified from an overall economic viewpoint.

Considerable efforts were made in the FRG likewise during the recent decade to speed up the development of new coal refining technologies. The development programs carried out jointly by industry and the government in the final analysis are aimed at a long-term, reliable supply of diversified and regionally balanced and raw material resources. The important thing is to make more use of coal reserves available domestically than has been the case so far in order to bring the use of mineral oil and natural gas into a suitable ratio with respect to the supplies available in longer-range terms and to counteract an incalculable price rise for those supplies.

In the past, the FRG spent an estimated DM 4 billion for carrying out such "coal refining" development programs. The amount might be taken as an indication of the significance which the government and industry assign to the expansion of coal refinement.

Ruhrkohle AG [Incorporated] currently extracts about 63 million t of hard coal and has stockpiles of 20 billion t. This fact alone clearly points up the interest, if not the obligation, which the enterprises have in expanding the "conventional" sectors of coal refining through coal liquefaction, coal gasification, and fluidized-bed furnaces.

To do this job, Ruhrkohle AG early in 1975 founded an affiliate which today is called Ruhrkohle Oel und Gas GmbH [Incorporated].

This company engages in the following activities:

Investigations of technical and economic utilization possibilities of new coal refining methods;

Technical process development through planning, construction, and operation of large-scale experimental and demonstration plants, considering the requirements of environmental protection;

Utilization of experimental results and the know-how acquired through planning, construction, and operation of production units;

And sale of products turned out in a form suitable for the market.

These tasks are being carried out by Ruhrkohle Oel und Gas GmbH in very close cooperation with partners and institutes, for example, Bergbau-Forschung GmbH and engineering firms. In order, in keeping with the goals, to achieve the production of products for the gradual replacement of petroleum and natural gas in the fastest and most economical fashion possible, the various development lines extensively relied on known basic principles of technologies used in the past for the gasification and liquefaction of hard coal.

The following is a report on the projects worked on and the development level achieved by Ruhrkohle Oel und Gas.

Coal Gasification

The selection of methods was essentially determined by two basic viewpoints:

Availability and quality of charge coal,

Production of market-oriented products, that is to say, mostly synthesis gas and heating gas.

Dust gasification methods are particularly suitable for generating synthesis gas; these methods are being implemented at high temperatures. Texaco, in the United States, has developed such a method on an experimental scale (15 t/d). To develop the method further, Ruhrkohle AG and Ruhrchemie AG have since early 1978 been operating a demonstration plant with a coal processing volume of 150 t/d or a synthesis gas output of 240,000 m^2/d. The following are the advantages of this method which must be stressed:

The method is independent of the coal quality (carbonization degree, water-ash content, grain size, caking properties);

The use of coal as suspension facilitates grinding, conveyance, and dosing without any problems into the reactor; there is no need for coal drying which uses up much energy;

Gasification at high temperature (about 1,500° C) leads to higher output rates; a crude gas is generated which is free of byproducts (for example, tars, phenols). Gas purification and waste water treatment are correspondingly simple. The fused mass of the mineral substance generates a slag which is ready for dumping.

Gasification is accomplished, depending upon the purpose, at pressures of up to 100 bar so that high specific outputs can be achieved in combination with favorable investment and compression costs.

The process as such has been described in literature on the subject several times (1, 2, 3, 4) so that in the following we will go into the results of the development project.

In the course of process-engineering and equipment development, it was possible to work out essential improvements for the various process stages. By influencing the grinding fineness of the charge coal and by using additives , the solid-substance content in the suspension was raised to 70 percent. This is decisive progress in view of the reduction of the specific O_2 requirement, reduction in the CO_2 content in the crude gas, and the increase in the efficiency. Changes in the design and the material of the burner improved the output and the operational safety of the gasification reactor. Comprehensive development work was required for the fireproof lining of the reactor in order to achieve adequate service life. The testing of the novel waste heat system leads to the extensive recovery of the detectable heat of the crude gas.

Development progress during experimental operation is illustrated by the plant's increasing availability. The operation today is characterized by a quiet and steady pace. The system can be started, controlled, and adjusted in the load range down to 20 percent without any problems. It is thus comparable to a conventional heavy-oil gasification system as far as operational performance is concerned. Early in 1980, synthesis gas from coal was successfully fed into the oxo [oxide] plant of Ruhrchemie AG. In the meantime it has also been possible to supply the methanization plant of Thyssengas AG with coal gas.

Since the opening of the "Holten Experimental Plant" about 42,000 t of coal were converted into about 75 million m^3 of coal gas during 8,000 operating hours. Eight different domestic and foreign coal types, with different ash and volatile substance content, including coal sludge with an ash content of about 38 percent, were used. All coal types were easily gasified with good yields. Below, we have some typical process data:

Processing rate	approximately 7 t/hr coal (wf)
carbon conversion	99% (without C-recycle)
Reactor temperature	1,350 to 1,550° C
Reactor pressure	40 bar
Slurry concentration	70%
Coal-gas efficiency	75%
Gas volume	13,000 m^3/hr (≙ 130% of design).

The process water is free of organic compounds. In addition to sulfides, ammonia, and chloride, it contains small quantities of cyanide. The waste water can be processed without any problems using conventional methods.

Plans call for continued operation of the "Holten Experimental Plant," in order primarily to test the gasification of residues from coal hydration.

Parallel to the technical development work, the economy of the process was also examined. At the end of 1980, a preliminary project was completed for the "Ruhr Synthesis Gas Plant" by direction of the federal minister of economy with the general specifications of a fixed location and a capacity of 50 t/hr of coal charge, corresponding to 80,000 m^3/hr of synthesis gas. Here are the essential results of the preliminary project:

The plant can be built from the engineering viewpoint;

Coal availability and gas utilization exist;

The synthesis gas generation costs on the basis of Ruhr region coal can compete with the production costs on S [heavy] heating oil if both plants are newly built;

If the licensing phase runs according to plan, the system can be completed in 1985.

The "Ruhr Synthesis Gas Plant" project is to be included in the coal refining program of the federal government. Lurgi pressurized gasification is the only large-scale industrial pressurized gasification method which has been tested in many ways and which has for several decades been used worldwide. Restrictions connected with the use of fine-grained and caking coal, pyrolytic constituents in the gas, such as higher hydrocarbons and phenols, as well as the relatively low specific gasification output were the reasons for the further development of the method which is being pursued jointly with Ruhrgas AG and Steag AG [Hard Coal Electric Power Company] within the context of the "Ruhr 100" project (5, 6, 7).

The essential innovations compared to the conventional Lurgi pressurized gasification method are as follows:

Rise in operating pressure in gas generator to 100 bar to increase the specific throughput and to increase the methane yield coupled with simultaneous reduction in the yield of higher hydrocarbons.

Installation of an additional gas outlet between the low-temperature carbonization zone and the gasification zone to evacuate "clear gas" which is almost free of low-temperature carbonization products; this results in reduced gas velocity in the upper part of the gasifier as a result of which the coal dust release is reduced. The usable coal grain spectrum can thus be broadened to include finer grains.

The tar oils and phenols remaining in the crude gas or low-temperature carbonization gas can if desired be hydrated in a thermal or catalytic crude gas cracking process. In case of thermal cracking and high temperature, all hydrocarbons, including methane, are reformed; we get synthesis gas. In case of cracking at low temperatures, only the condensable hydrocarbons are cracked and the methane remains preserved.

These innovations are currently being tested in engineering terms through the operation of the "Dorsten Large-Scale Experimental Plant" which daily can process 75-170 t of coal, depending upon the pressure.

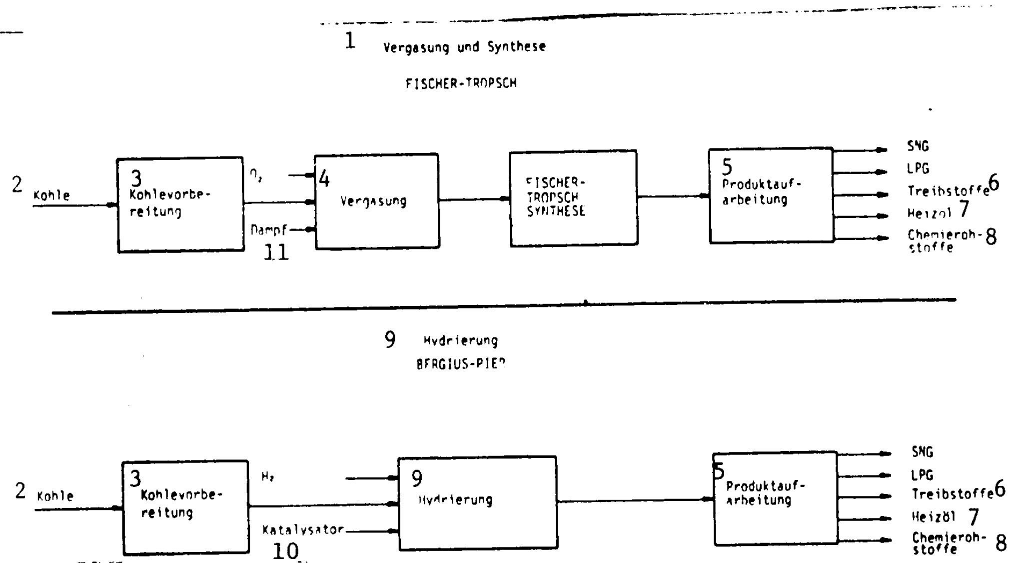

Figure 5. Coal liquefaction processes. Key: 1--Gasification and synthesis; 2--Coal; 3--Coal preparation; 4--Gasification; 5--Product processing; 6--Fuel; 7--Heating oil; 8--Chemical raw materials; 9--Hydration; 10--Catalyzer; 11--Steam.

In the case of "Ruhr 100," the coal is raised to operating pressure by means of two alternately operated locks and via the coal distributor gets into the gas generator. Here it is first of all heated up by the gas formed in a countercurrent and it is then dried; after that it is carbonized at low temperature and gasified with O_2/steam. The remaining coke is burned in the lower part of the gas generator to meet the heat requirements.

To break the coke cake open, after it has developed in the low-temperature carbonization zone, we use a stirrer attached to the coal distributor with three vanes at varying levels. The rotary grill in the lower part of the gas generator distributes the gasification agent uniformly over the shaft cross-section, carries the coal filling, and transports the ash into the release lock.

The gas leaves the gas generator via the low-temperature carbonization gas or clear-gas outlet. Through direct injection of water, it is cooled and saturated and simultaneously relieved of any dust and tar mist. In subsequently connected waste heat boilers, the gas is almost completely cooled off along with the generation of low-pressure steam. Clear gas and low-temperature carbonization gas are then processed together and are piped into the network of Ruhr Gas AG.

The "Dorsten Plant" became operational in September 1979 and, during about 2,000 operating hours, it gasified about 5,200 t of coal and about 7.5 million m^3 of converted gas were generated.

Here are the essential results from 13 different runs:

Increase in specific gas generator output by 30-60 percent, depending upon the type of coal, compared to the gas generators operated earlier in Dorsten. In case of short-term operation with clear gas evacuation, it was possible almost to double the gas generator output.

Increase in methane yield from 9 to 16 percent by volume in crude gas as result of higher operating pressure.

Improvement in cold-gas efficiency by 7 percent along with definitely decreased O_2 requirement.

The fine-coal share of the charge coal temporarily came to as much as 40% < 6 mm.

Experimental operation is for the time being continuing only with low-temperature carbonization gas evacuation because a new concept is to be worked out for clear gas evacuation. During the next experiments, the operating pressure will be raised to 90 bar in order further to increase the output; furthermore, the yield of liquid hydrocarbons is to be determined as a function of the operating pressure and agglomerated fine coal (briquettes) are to be put through.

For the purpose of the commercial utilization of "Ruhr 100" development, Ruhrkohle Oel und Gas together with Ruhrgas AG by direction of the minister for small business and transportation of the State of North Rhine-Westphalia prepared a preliminary project outline which combines the construction of a gasification plant with a coal-fired power plant. IAR ("Ruhr Industrial Plant") is designed for a coal processing rate of 3 million t/yr with a 3-stage construction program. Depending upon market requirements, the plant can turn out about 1.6 billion m^3 natural gas exchange gas (SNG) or approximately 2.3 million t methanol or both products together in a joint production program.

According to plan, the first expansion step can go into operation with one-third of the final capacity in 1988, provided the licensing procedure can be taken care of briskly. A location in the Ruhr region offer favorable prerequisites for the construction of the plant. The investment requirement for the first phase is about DM 1 billion. The project was proposed by Ruhrkohle AG/Ruhrgas AG for inclusion in the federal government's coal refinement program.

A significant task, oriented toward the future, has been assigned to Ruhrkohle Oel und Gas in the utilization of nuclear process heat for coal refining.

In the case of the PNP ("Prototype Plant for Nuclear Process Heat") project, the share of coal (about 40 percent) is to be replaced through energy supply from a nuclear reactor which, in autothermal gasification processes, is used for the generation of reaction heat.

Ruhrkohle AG and Rheinische Braunkohlenwerke AG in 1978 established a planning company for the planning, construction, and operation of a 500-MWth HTR prototype plant. The development work for the hard coal gasification segment was done by Bergbau-Forschung GmbH. The overall project is being promoted considerably by the BMT [Federal Ministry for Research and Technology] and the MWMV/NRW [Ministry for Small Business and Transportation] [North Rhine-Westphalia].

Coal Liquefaction

The two basic methods for the liquefaction of coal are illustrated in Figure 5. In the case of the synthesis method according to Fischer-Tropsch, synthesis gas (H_2, CO) is generated through gasification of coal with O_2/steam and from that synthesis gas it is possible to build up liquid hydrocarbons through catalytic steps.

In the case of direct hydration according to Bergis-Pier, hydrogen is deposited against the "high-molecular coal" in the presence of catalyst. We get smaller, hydrogen-richer molecule bonds [molecular compounds]. As a function of the quantity of deposited hydrocarbon, influenced by the reaction conditions (p, T), we get coal-oil with differing boiling point.

Another possible method in direct hydration is the treatment of coal under pressure with a hydrogen-yielding solvent according to Pott-Broche. The coal is depolymerized here and nascent hydrogen from the solvent is deposited against the coal.

These coal liquefaction methods were developed in Germany and were used on a large-scale industrial basis during the thirties and forties. The Fischer-Propsch method, compared to direct hydration--related to the output of fuel and heating oil--uses more energy and is mostly more expensive. Ruhrkohle AG decided in favor of the further development of the method of direct hydration and during the second half of the seventies participated in four different development undertakings which worldwide are considered the most important.

If we compare the main process plants in these projects to each other then we clearly see the extensive agreement in the process involved in the following technologies to be developed: "German technology" (DT), "H-Coal" (HRI), "Exxon Donor Solvent" (EDS), and "Solvent Refined Coal" (SRC-II).

In the case of German technology (Bottrop Project), the charge coal is mashed, after addition of a catalyzer (iron oxide) with oil generated during the process and is hydrated after the supply of hydrogen at 300 bar and 475° C. During the subsequent separation of the products, we essentially get liquid gas, as well as light and medium oil. The liquid products can be further processed through refining and reforming so that we may get gasoline and heating oil. The hydration hydrogen needed is generated due to the gasification of the vacuum residue.

According to the H-Coal method (HRI--Catlettsburg Project), the coal is mashed together with cycle oil and, after the addition of hydrogen, it is hydrated at 185 bar and 450° C in the presence of a higher-grade catalyst (cobalt oxide, molybdenum oxide). As products, we get--depending upon the method used--distillates (Syncrude) or a mixture of distillable and nondistillable components (fuel oil). The liquid products can be processed into gasoline and heating oil through refining, reforming, and hydrocracking. The hydration hydrogen needed is again generated through gasification of the hydration residue.

The Exxon Donor Solvent method (EDS--Baytown Project) works without the addition of catalyst in the slurry [semisolid] phase. The coal is mashed with hydrogen-releasing solvent and is hydrated with addition of molecular hydrogen at 140 bar and 425-480° C. The reaction products are then separated. The solvent, obtained through distillation is hydrated for renewed use catalytically in the solid-bed reactor. The solid-containing residue can be processed into liquid products, gas, and coke through coking (flexicoking) or it can be converted into hydrogen needed for hydration through gasification. The liquid products obtained can here again be processed into gasoline and heating oil through refining, reforming and hydrocracking.

In the case of the Solvent Refined Coal Method (SRC-II--Morgantown Project), the sulfur-rich charge coal is mashed with returned mash which has reacted, that is to say, without addition of outside catalyst, and with oil generated in the process, and it is hydrated with hydrogen at 130-150 bar and 450-465° C. During the separation of the products, we essentially get SRC-II coal-oil, crude naphtha, and light hydrocarbons. For the generation of gasoline or heating oil, we need refining, hydrocracking, and reforming of these liquid products. The necessary hydration hydrogen is generated through gasification of the vacuum residue. In the following we will describe the development of the individual products and the current state of the art.

On the basis of results from earlier IG [trust] coal hydration plants, which BASF [Baden Aniline and Soda Factory] was kind enough to make available, it was possible, in cooperation with the "veteran hydration experts" (Dr. Ambros, Dr Kroenig, Dr Raichle, Dr Jaekh), to develop the concept of the "German technology" (8). The latter differs from earlier IG methods in some essential features, such as, for example, reduction in the processing pressure from 700 down to 300 bar, coal-oil separation through distillation and gasification of hydration residue, including the asphaltenes for H_2 production. At simultaneously improved heat recovery, we can expect an increase in the specific coal processing volume by about 50 percent and a rise in the thermal efficiency by 25 percent (9).

The experimental backup support for this concept was first handled by Bergbau-Forschung GmbH through the construction and operation of a continually working pilot plant. The results from experimental operation were fed into the preliminary project for the construction of a large-scale experimental plant carried out parallel by Ruhrkhole Oel und Gas in 1976-1977. After completion of the preliminary project, the decision was made at the end of 1977 to build and operate the Bottrop Coal-Oil Plant (10). The Bottrop location offered advantages because it was possible to establish a low-cost supply and waste removal setup with the adjoining Prosper Coking Plant. Construction began in 1979; the plant was completed in terms of machinery two years later. The various plant divisions have been placed in operation in succession since February 1981. The hydration of the first coal shipment is expected for the third quarter of 1981.

The project is connected with an experimental program for the further processing of coal-oil. On the basis of different composition of mineral-oil and coal-base oils, it is necessary to develop special processing methods. The low sulfur content, the relatively high nitrogen content, and the oxygen content, which is practically entirely missing in mineral oil, are characteristic of coal-oil. The high density and the low hydrogen content are also specific for coal-oil.

On the grounds of Veba Oel AG in Scholven, a trial plant was built for this development work; the suitability of coal-oil as preliminary product for fuel and heating oil production as well as chemical raw materials is being examined in that trial plant. The coal-oil is first of all broken down through distillation into easily-boiling, medium-boiling, and slow-boiling fractions and the individual fractions are then processed further separately. Light-weight and medium-weight oil are subjected to cold hydration with subsequent refining. The refined medium-weight oil can be used as admixing component for EL heating oil [extra light?]. Additional possibilities are the hydration of medium oil under higher pressure into diesel fuel or hydrocracking of medium oil into gasoline. Heavy oil is refined and is cracked into gasoline and medium distillates through hydrocracking.

The entire project is being carried out by Ruhrkohle AG and Veba Oel AG. The total expenditure for the undertaking, which is being considerably promoted by the minister of economy, small business, and transportation of the state of North Rhine-Westphalia, comes to about DM 400 million.

The H-Coal Pilot Plant at Catlettsburg, in the United States, is designed for a coal processing rate of 200 or 600 t/d, depending upon the process used.

The U.S. Department of Energy, the Commonwealth of Kentucky, Ashland Synthetic Fuels Inc, and Mobil Oil, Conoco, and Standard Oil, as well as the Electric Power Institute, and Ruhrkohle AG are involved in the project together with Veba Oel AG.

The H-Coal method is based on the development of the ebullated-bed reactor for the refining of heavy, highly sulfur-containing crude oils and residue oils. It was used for the first time in 1964 for the catalytic hydration of coal. After many long years of development work on a laboratory and trial-plant scale, engineering work was started on the Catlettsburg pilot plant in 1975. The plant was placed in operation at the end of May 1980. The project costs amount to about $300 million. The German share is being contributed by the minister of economy, small business and transportation of the state of North Rhine-Westphalia in the context of the Bottrop Coal-Oil Plant project.

Two operating methods are to be tested in the plant: the generation of distillates ("Syncrude") at a coal processing rate of 200 t/d and a coal-oil yield of about

80 t/d and the generation of a mixture of distillable and nondistillable coal-oil (fuel oil) with a coal processing rate of 600 t/d and a coal-oil yield of 220 t/d.

After initial difficulties, the plant in 1980 achieved about 400 operating hours at 50 percent maximum operating rate, using the Syncrude Method. After comprehensive repair and refitting work, the plant was operated successfully in 1981. During the first half of 1981, about 7,000 t of coal were processed during 45 days of operation. The preliminary experimental results confirm expectations regarding process development. Experimental planning for 1981-1982 calls for another two test runs using the Syncrude Method. An eastern American coal (Illinois No 6) and western American coal type (Wyodak) are to be tested. Test runs using the fuel-oil method are being suspended for the timebeing because the sales plans for the H-Coal method are within the Syncrude range.

Since the beginning of 1979, Ruhrkohle AG has been participating in the "200-t/d Baytown Coal-Oil" project. With Exxon as project manager, the U.S. Department of Energy, of Electric Power Research Institute, the Japan Coal Liquefaction Development Comp, Philips Coal Com., Arco Coal Comp., Ruhrkohle AG, and AGIP [National Italian Oil Company]are partners in this project.

The engineering work was begun in 1974 and construction work for the Baytown plant was started in 1978. The plant was opened in the middle of 1980.

The cost of the project comes to about $370 million; the RAG [Ruhrkohle AG] share is essentially promoted through the federal minister of research and technology.

In 1980-1981, the plant was able to process about 40,000 t of coal during about 4,000 operating hours; the availability came to about 72 percent. The longest experimental run lasted about 5 weeks with an average processing output of about 60 percent of nominal output. In June 1981, the plant was converted in order to test a variation in the operating method, that is, the return of residues. The experiments run with so far with Illinois Coal No 6 were completed in May 1981. The continuing experimental program until 1982 calls for the use of Wyodak and Big-Brown Coal.

Ruhrkohle AG has since 1974 been involved in planning the 6,000 t/d SRC demonstration plant in Morgantown as a partner of Gulf Oil Company. In 1979, an agreement was concluded between the U.S. Department of Energy and the federal minister of research and technology concerning 25 percent German participation in the project. A government treaty between the United States and Japan on 25-percent Japanese participation followed in 1980.

Because of the tight financial situation in the United States and in the FRG, the project's financing was again reviewed by the government in both countries in 1981. Because the project costs, which had been estimated at about $1.4 billion, cannot be taken care of due to budget cuts at this time, the three participating governments in June 1981 agreed to terminate the project.

Participation in the various hydration projects provide Ruhrkohle Oel und Gas with a valuable increase in this field. Cooperation in development undertakings at the same time also permits a well-justified comparison of the individual methods from engineering and economic aspects.

German technology remains the main point in process development. The operating results of the Bottrop coal-oil plant are to constitute the basis for the next step to the sale of this technology. A preliminary project for an industrial plan was prepared by direction of the minister of economy, small business, and transportation of NRW in 1979-1980. This preliminary project investigates the technical feasibility, site and environmental protection problems, charge coal availability, product sales possibilities, practical implementation, timetable, and economic aspects.

The size of the plant was designed for a coal processing volume of about 6 million t/yr in hydration. The expansion scale compared to the 200-t/d plant in Bottrop is in the technically feasible and meaningful range because the plant has been designed in the form of four phases to be erected, one after the other, in terms of time.

In the final phase, such a plant can produce about 1 million t/yr of naphtha, about 2 million t/yr of medium oil, and about 0.6 million t/yr of LPG. Naphtha can be used as reformer feed for the fuel sector or as chemical raw material for the production of BTX-aromatics. Medium oil can be considered as substitute for petroleum-base heating oil.

Another step toward large-scale industrial use of the German technology is being taken together with a German consortium which, in the context of a feasibility study, is examining the technical and economic possibilities for the construction of a fuel plant in Australia with an output capacity of about 3 million t/yr.

The plant concept, depending upon the location, provides for a combination of coal hydration and Fischer-Tropsch synthesis. Carburetor fuel and diesel fuel are to be turned out as products. The planning work will be completed in October 1981.

Fluidized-Bed Furnaces

For the heat market, direct coal combustion in heating plants and thermal power plants, as well as industrial process heat generation, are increasingly gaining significance.

The stepped-up expansion of district heat supply with generating plants near to the consumer and correspondingly favorable distribution costs calls for heat generators with low emission because of the fact that residential areas are mostly heavily contaminated with high immisions even before that.

WSF (fluidized-bed furnace) is suitable for heat generation in the above-mentioned sectors on account of its particularly high degree of environmentally safe operation and the fact that it is so "undemanding" compared to the fuel quality used.

Under the "environmentally safe power plant technology for coal power plants" programs, promoted by the federal minister of research and technology, Ruhrkohle AG took over the job of developing and testing atmospheric WSF in two demonstration plants.

Since 1977, the following WSF projects are being carried out: 35-MWth WSF plant at "Flingern" and 6-MWth plant at "Koenig Ludwig." In terms of capacity and engineering design, both plants were intended for certain application ranges: the 6-MWth plant has typical small boiler for process heat generation in the industrial sector and for decentralized heat supply in the community sector, the 35-MWth has steam generator unit for larger heating plants and thermal power plants.

The operation of two demonstration plants facilitates the simultaneous testing of various technical concepts, for example, for fuel charging (mechanical, pneumatic) and the boiler principle (natural cycle, forced cycle).

Both plants were commissioned during the third quarter of 1979. Here are the consumption and production figures as of the end of April 1981.

	Flingern	Koenig Ludwig
Steam generation	105,000 t	29,500 t
Coal consumption	14,500 t	3,800 t
Operating hours	4,300 t	4,600 t

After successful completion of experimental operation, the Flingern plant was closed down of 30 April 1981.

Concerning harmful substance emission, the experimental operation of both plants yielded absolutely positive results and thus proved that WSF is environmentally safe to a high degree:

In the course of extensive series of experiments for desulfuration, the SO_2 content in the flue gas was determined as a function of the type of coal, the operating conditions, especially the temperature, and the ratio between lime added and the sulfur content of the charge coal; at an optimum temperature of about 830° C, favorable desulfuration degrees of 75-85 degrees were achieved at Ca/S ratio of 2.0-2.6.

The NO_x emission was determined for various operating parameters as a function of the N content of the charge core; NO_x contents of <1,000 mg/m^3 in the flue gas were achieved.

The boundary value of 100 or 150 mg dust/m^3 pure gas, which is required for licensing, was definitely underbid.

The furnace efficiency, which is important for the economy of the WSF method, was increased to more than 95 percent after improvements in the equipment.

The operating performance of WSF plants regarding starting and stopping as well as load regulation is absolutely comparable to the conventional steam generator in this performance category.

Experimental operation of the "Koenig Ludwig" Plant is being continued. The emphasis in development will be on component testing and optimization; gradual automation, especially for the supply and waste removal systems; and testing the use of fine-grained fuels.

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Dedicated to Professor Dr. rer. nat. Werner Peters on his 60th birthday.

Authors: Dr J. Langhoff, Dr R. Duerrfeld, Dr E. Wolowski, Ruhrkohle Oel und Gas GmbH, Gleiwitzer Platz 3, D-4250 Bottrop.

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TRANSPORTATION

A 320 DEVELOPMENT SCHEDULE, TECHNICAL DATA

Paris AIR & COSMOS in French 19 Sep 81 pp 31-33

[Article by J. M.: "1986: The Future A 320 (135-172 Seats)"]

[Text] In June, at the time of the Bourget Exhibition, we were able to publish a summary of the first information relased relative to Airbus Industrie's future A 320 (formerly SA-1/SA-2) (see AIR ET COSMOS No 864, pp 31-35).

The A 320 is now closer than ever to being unveiled. We therefore present here to our readers the future plane in the form of a more detailed set of technical data, updated insofar as concerns its calculated performance characteristics, excerpted from a more recent document dating from the month of August.

The decision to produce the A 320 was announced at Bourget by the management of the European consortium, armed with Air France's choice of the plane in the form of a provisional decision: an order for 50 planes, 25 of which on option, with a binding down payment (10 million francs)--symbolic, certainly, but a non-negligible factor leading to the mentioned announcement. A timetable has now been set up as follows:

--March 1984: Assembly of the wing unit and fuselage of the first plane;

--December 1984: First flight;

--January 1986: Certification of the first version; entry into service;

--March 1986: Certification of the second version.

In setting up this timetable, Airbus Industrie is undoubtedly taking a risk; but the risk would have been greater if the European consortium had not taken the mentioned provisional decision, taking advantage of the situation in which Boeing finds itself wherein, after having launched its B 737-300 program and announced the start of studies on a B 727-200 RE, it has very obviously been compelled to delay until 1988 the roll-out of its future B 7-7 so as not to interfere with the marketing of the two above-mentioned planes. If this timetable is maintained, Airbus Industrie should be the first to bring out a 150-seater of modern design.

The proposed timetable, based as it is on a 55- to 56-month developmental spread, appears reasonable. The obstacles to be overcome include the necessary agreement on the distribution of responsibilities (see AIR ET COSMOS No 870 p 8), the formal commitments by the governments, and the availability of the engines: Although three types of engines are, technically speaking, in the running, all capable of providing the high levels of performance demanded (CFM 56-2000, RJ-500-35, and PW 2025), the fact is that the developmental timetable for these three engines does not really coincide with the one for the plane, unless the latter are initially equipped with provisional engines. Indeed, this problem could all the more easily be resolved if the A 320 could go into service with an engine derived directly from the present CFM 56... .

The first feature that is being specially promoted by Airbus Industrie is the diameter of the fuselage: It has been carefully chosen to satisfy the demand on the part of passengers for greater comfort as well as that on the part of the airlines for greater commercial viability, that is, the ability to transport, in the baggage holds, containers like those of the present LD 3, hence "compatibility" (without involving any real trade-off) with the baggage holds of the larger planes.

By comparison with the standard Boeing fuselage, that is, that of the B 707/727/737/757, that of the A 320 thus provides greater interior room (6 inches, or 15 cm), which will mean:

--wider seats, more ceiling headroom;

-- larger luggage compartments inside the cabin (above the seats): 62 dm^3 per seat versus 51 for the Boeing fuselage and 39 for the DC 9;

-- wider but also higher baggage holds (1.22 m versus 1.11 and 0.99 m).

In "business" class, that is, with five seats per row instead of six, the seat widths will be identical to those found in first class on the B 767 and the DC 9.

From the technical standpoint, it features the planned use of:

--active control over elevator and stabilizer surfaces;

--simple but effective high-lift devices;

--improved lightweight alloys and composite materials on a large scale (fin, elevator, flaps, spoilers, ailerons, cowlings, fairings, landing-gear hatches, floor panels);

--color cathode-ray tubes, etc.

Of course, the cockpit is designed for a crew of two.

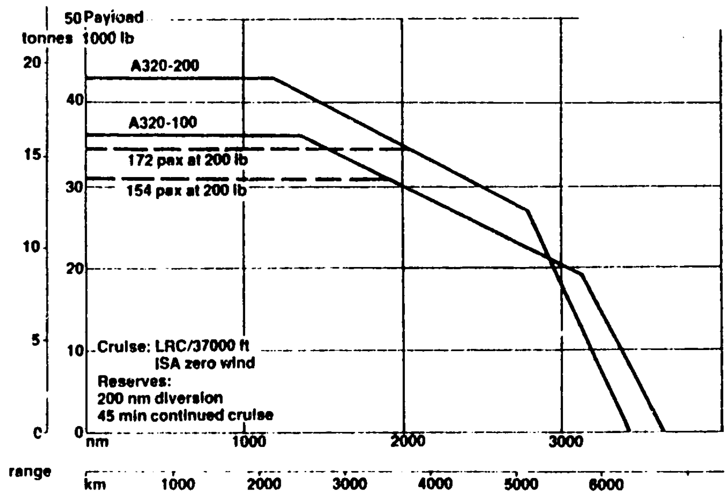
All of these features will be backed by the experience already acquired, in most cases on the A 300, the A 300-600 and the A 310. The user will therefore not be exposed to unwelcome surprises. Aerodynamic studies on numerous wind-tunnel models are already at an advanced stage at the plants of all the partners. The total wind-tunnel test time now exceeds 3,500 hours.

Noteworthy also is the operational life of the structure: 60,000 1-hour flights.

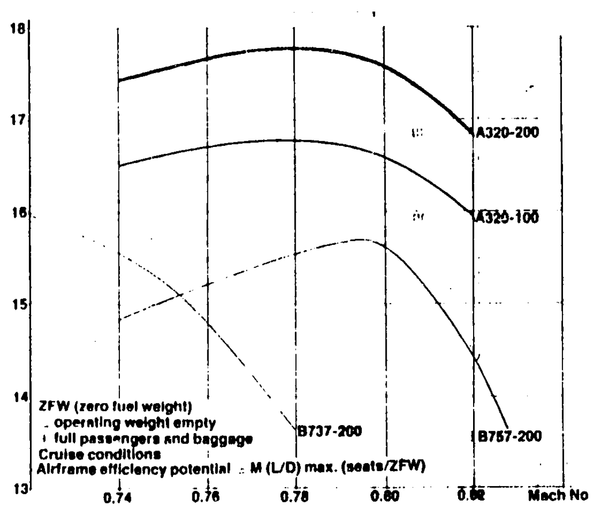
The calculated performance characteristics charted hereunder and on the following pages may be summarized as follows: Fuel consumption 40 percent less than that of the B 727-200 and operating cost 20-25 percent less. Its gains with respect to the B737-200 are, respectively, 30-35 percent and 18-20 percent. The interest being shown in the European plane by airlines such as, in the United States, Eastern and Delta is therefore understandable.

Comparative Characteristics of the Two Versions

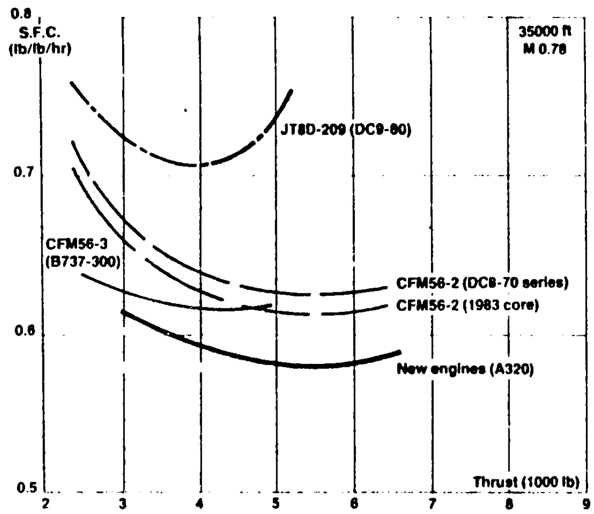
Parameters	A 320-100	A 320-200
Wing span (m)	34.57	34.57
Overall length (m)	36.04	39.24
Overall height (m)	11.85	11.85
Number of seats at row-spacing of 32 inches	154	172
Number of seats at mixed spacing	135 (12 + 123)	156 (12 + 144)
Capacity of forward holds (m^3)	13.6	18.3
Capacity of rear holds (m^3)	25.1	29.9
Total capacity (m^3)	38.7	48.2
Fuel capacity (kg)	18,800	18,800
Operational weight, empty (kg)	38,478	40,835
Maximum weight at take-off (kg)	66,000	71,900
Maximum landing weight (kg)	60,700	65,700
Maximum weight less fuel (kg)	54,900	60,400
Maximum payload (kg)	16,422	19,565
Passenger load (at 32-inch row-spacing) (kg)	13,971	15,604
Cargo load (kg)	2,451	3,961



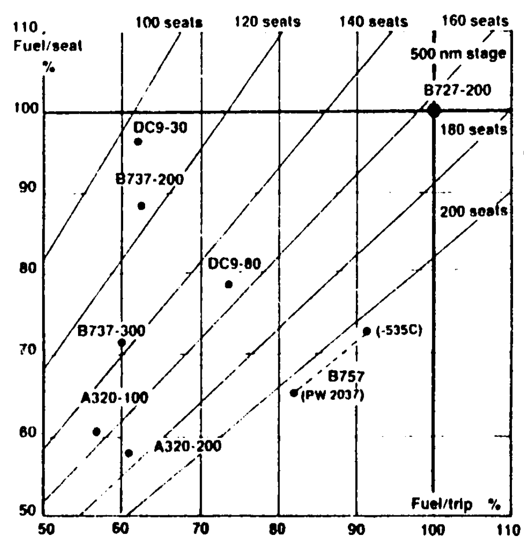
Latest edition of payload-range curves, updated with respect to those released in June.



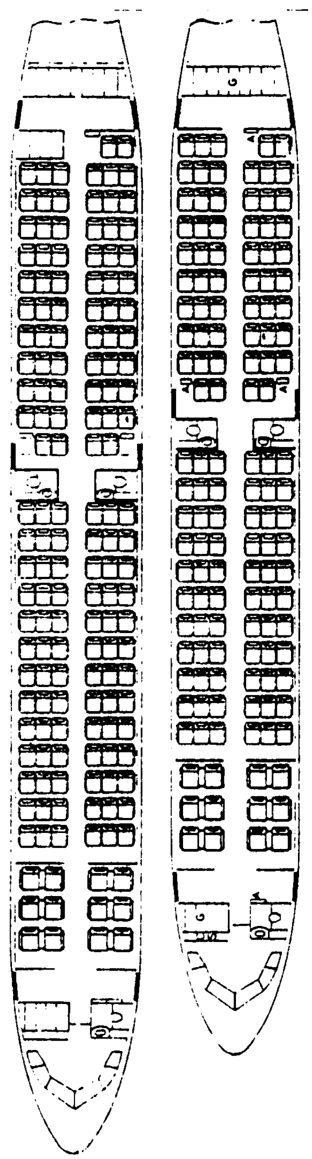
Comparison of A 320 efficiencies with those of the B 737-200 and the B 757-200.



Comparative engine performance characteristics.



Comparative fuel/seat and fuel/trip consumption characteristics.



Standard seat arrangements on the A 320-200 (mixed: 12 + 144 = 156 seats) and the A 320-100 (mixed: 12 + 123 = 135 seats).

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TRANSPORTATION

FIRST FLIGHT TESTS OF BRITISH AEROSPACE 146 SUCCESSFUL

Paris AIR & COSMOS in French 19 Sep 81 p 15

[Article by J.M.: "Hatfield: First Flights of the BAe 146"]

[Text] The first flight tests of the BAe 146-100, which began on 3 September at Hatfield (see AIR & COSMOS No 872 p 15), taking into account the purpose of this quadruple jet (capability of using short airfields), focused upon flight characteristics, take-off and landing included, with deflected wing flaps (Fowler, with double slots).

This entire first flight, of 95 minutes duration, was effected with the trailing edge flaps deflected 24°; the take-off is known to have required only 17 seconds and was made at about 108 knots but the airplane weighed less than 29 tons, the planned maximum weight being 33.8 tons. The landing gear was retracted, then reextended; the greater part of the flight having been made with the landing gear extended, the measured fuel consumption was hardly significant, all the more so as the flaps were also extended and because of this the speed remained lower than 200 knots (370 km per hour). In 95 minutes of flight, ceiling at about 10,000 feet, the four AVCO Lycoming ALF 502R-3 turbojets (static thrust: 3 tons) thus consumed nearly 4 tons of fuel and the plane put down with weight of about 25 tons, the flaps all the time deflected 24°. It is interesting to observe that during this first flight the airbrakes located at the rear of the fuselage were used, during the approach as well as in landing. The use of these airbrakes, flaps and spoilers, combined, should in fact permit best possible control of the angle of approach and then of braking on the ground without recourse to thrust reversers.

Still on the subject of take-off and landing, let us recall that the BAe 146 landing gear was developed from an original scheme of the Messier-Hispano-Bugatti firm, accepted at that time by Hawker-Siddeley Aviation, and then passed on to the Dowty-Rotol firm. However, Messier-Hispano-Bugatti is mass producing the main structural element, which is the landing gear cylinder, at its Bedow plant, the remainder being manufactured in Great Britain.

This landing gear with telescoping twin-wheel bogie is a fuselage gear which, with lateral retraction and shortening, makes it possible to adapt to the requirements of the wheel gauge (4.72 meters) and limited space once the gear is retracted. In the matter of French industry participation in the BAe 146 program let us also point out the presence, aboard this first flight of the BAe 146, the new TRT AHV-530A (ARINC Standard 552A) digital radioaltimeter. Other French suppliers: Forgeal, Le Magnesium Industriel, and Raychem France.

Also during this first flight the crew was able to proceed with operational tests of the systems: electronic, hydraulic, pressurization, air conditioning, and APU [auxiliary power unit], and to make a preliminary testing of the stability and pilotability about the three axes, going so far as even evaluating the damping of "Dutchman's roll" with and without attenuators, and maneuverability with the exterior starboard motor idling.

The days which followed enabled British Aerospace to perform, with the BAe 146 No 1:

a second flight of 35 minutes duration with the flaps deflected 30°; and
a third flight with the flaps deflected 18° (planned maximum: 33°).

The airplane should supposedly fly 15 hours before flutter tests (in flight) with use of an hydraulic exciter begin. The exploration of the flight regime, the stability and maneuverability tests, and the flutter tests should take about 6 weeks; at the end of that time an anti-stall parachute, necessary for limiting the risks during tests of low speed flight, stalling, and sensitivity to buffeting, will be installed.

The BAe 146 No 2 should fly in November, the No 3 airplane in January; a fourth airplane will fly later, about April or May. These four airplanes will have flown a total of 1,200 hours before certification, hoped for in August 1982, is obtained.

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TRANSPORTATION

RENAULT'S DOUAI PLANT HIGHLY AUTOMATED

Paris L'EXPRESS in French 2 Oct 81 pp 106-106

[Article by Michel Jacques: "Robots Are Not Armless"]

[Text] To put a halt to the Japanese invasion, Renault has chosen new allies: Robots. In its front line: Its Douai plant.

This is the other major event marking the return from the vacation period. Less spectacular, no doubt, than the launching of the TGV [high speed trains], its impact is nevertheless considerable. With the Regie Renault's new production unit now being put into service at Douai, in the North, which will be its R9 production tool, France will have one of the world's most highly automated plants -- a plant that will still be employing 7,000 persons but where 125 robots will be doing, all unto themselves, a very large part of the welding and materials handling involved in the manufacture of a vehicle.

It is about time! The Japanese car invasion is not waiting. The reason their cars are coming into the Western markets at low prices is to a great extent owing to the fact that their production is robotized. Hence it is on that terrain that battle must be done. Clearly, robots are following the historic trend. Having made their entry into shops over the last few years, they are competing there with human beings, without inhibitions and for a cause. Being at one and the same time awkward yet precise, comical yet disturbing, they paint, weld, cut, and handle parts and materials, often exceeding fiction, without, however, resembling it. Nothing stops them. They already had arms and a memory: Now they are starting to see and to "think." Some are even capable of reproducing themselves... We are at the dawn of a new industrial revolution. A turn that the French automobile industry cannot afford to miss, and that it is preparing in good time to negotiate.

"Douai is not the child of a spontaneous conception; it is the product of a series of continued efforts," points out Claude Grappotte, a member of the Renault management. The fact is that the Regie has introduced robotics very widely into its Flins (Yvelines) and Mans (Sarthe) plants, even though it embarked on this route some 10 years later than did the American manufacturers. According to its engineers, there is no "gap" with respect to the United States and to Japan. "The Japanese," they say, "count anything as robots." By their definition, Renault and Peugeot S.a. have between them 16,000 robots, or, as many as the Japanese industry."

Exactly what is a robot?

The automation of industrial operations does not date back to only yesterday. Transfer machines have been used in the Renault plants since immediately following the Second World War. These were marvels of equipment at that time and are still useful today. But they are machines that do the same things time after time, like beasts of burden, one might say. The robot is not limited by the same constraints: It is flexible, easily programable, and can perform different operations on demand. "The life of a transfer machine," says one engineer, "is, broadly speaking, like that of a given model of automobile, in that, when the model is changed one scraps the old one. With a robot, on the contrary, one need only change the program.

The Great Leap Forward

For actually, it is first of all a manipulator: An arm at the end of which is mounted, as required, a welder, a miller, or a materials handling tool, somewhat as a do-it-yourselfer might adapt his sander or his circular saw to his drill press. But industrial robots have a flexibility that is little short of astonishing.

On the Douai welding line, the robots can process R5's and R9's on the same line, one after another, in any order: A simple magnetic card enables them to adapt to the situation case by case. The same is true at Flins. There, a comical bird--half ostrich, half brontosaur--pecks away obstinately at an R18 carcass: It is the painting robot. The flexibility of these "vertebrates" enables them to paint even the inside of the body. Above all, it itself changes colors as required and adapts its motions to each type of vehicle.

These are not the only smart robots. Others, at Biderman (textiles), sew buttons on and cut textiles by means of lasers. And even more impressive is a robot equipped with a television camera--the equivalent to it of having an eye--that can distinguish... 1,000 billion different shapes!

Record achievements, just the same, in that, there are many generations of robots of varying degrees of evolution. The most common equipment of this genre are numeric-controlled machine tools. An echelon above these are the programable manipulators, capable of "learning." And at the summit are the robots equipped with a sensor, a true sensing organ, which no longer repeats the same motions endlessly, but "invents" variants in accordance with the environment.

"None of this would have been possible," emphasizes Pierre Pardo, father of the Regie Renault's robots, "without microelectronics, which has increased to an incredible degree our calculating powers." The great leap forward was, beginning in 1970, the advent of the microprocessor. Just 10 years ago, the robots in a plant were all tied into the same computer weighing tons and worth a fortune. Microprocessors enabled the miniaturization of equipment and the bringing down drastically of costs. Suddenly, the computer began to be mounted directly into the body of the machine: Each robot was given its own brain.

Was this a unique miracle of technology or was it real progress? Whatever the answer, production has benefited from it in terms of quality. Through the use of welding robots, a better positioning of the vehicle's components is possible, reducing noises and aging of the vehicle. In terms of money, it is not that simply put. "Initially," says Max Richard, head of the Flins plant, "the installation of robots was, as is true in all cases of experimentation, a heavy additional cost. But its true venue is Douai."

Robots are certain, sooner or later, to pay for themselves. This has been shown to be the case, for example, by CFAO [Computer-Assisted Design and Manufacture], another aspect of robotics. It used to take an average of 2 months at SEB [expansion unknown] to bring out a new model of pressure cooker. With CFAO, the engineers "pop" the data into the computer, and, 1 hour later, out comes the design. For added measure, it is in the form of the program needed by the numeric-controlled machine that will fabricate the stamping press for the cooker. Result: The first cooker can come off the production line the next day. In the Dassault design department at Saint-Cloud also, the drawing board has been replaced by the computer. Suddenly, everything advances more rapidly: Whereas before, it took 4 months to complete the plans for a wind-tunnel maquette of a plane, today, 4 days are enough.

The Douai Monsters

But what is there in this for the workers? Robotics does not always have profits as its motivation; sometimes its aim is to improve working conditions. The good-fellow robot who does the "dirty work" of painting in the shop undoubtedly merits a tip of the hat. In the welding operation as well, automation eliminates annoying and tiresome work. Nevertheless, all the fallout from robotics is not a shower of roses: The most disturbing aspect in terms of the long haul has to do with jobs. By 1990, Renault estimates that, for the same level of production, robotization will have eliminated 12 jobs in manufacturing out of 100. With compensations, of course.

Robotics as a whole involves a reduction in the number of skilled factory workers. But it requires a greater number of highly skilled service personnel, inasmuch as it generates the need for operational control and maintenance. This often means promotions for the personnel in the enterprise itself. At Douai, the 35 welding robot operators are all at the BTS [Diploma of Advanced Technician] level: They were all recruited, following appropriate training, from among the plant's own personnel. At Mans, where a fully automated 150-meter-long production line has been installed, seven men are enough to "drive" the monster. Highly qualified, they were actually chosen from among the plant's factory-worker personnel: A training period to bring them up to the required level turned the trick.

The union leaders are nonetheless concerned: "People are being put through demanding training courses and, when all is said and done, they are given but a mere supply or monitoring job," say officials of the CFDT [French Democratic Confederation of Labor]. Another concern is: Since robots are very expensive, they are given virtually no rest. Suddenly, the need will arise for job crews, hence night work: The opposite of progress.

A point on the positive side is: The manufacture of robots creates jobs. This is especially true in the case of Renault, which builds its own automation devices, through the intermediary of its subsidiary Alma-Cribier. The latter is moreover a leader of the the French robotics industry, which includes manufacturers such as Peugeot S.a., SORMEL [Company for the Study of Electrical and Mechanical Clockworks], AFMA [expansion unknown], Scinky, etc.

Douai is yet but a stage, and the robot revolution is but starting. The most difficult part lies ahead: Moving into the assembly stage, a technique that is likely to take several years to master. Robots will of course never do everything. But already, some of them are shrewd enough to go searching in a stack of parts for exactly what they need. Or to assemble all by themselves an entire automobile transmission... .

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TRANSPORTATION

NEW GENERATION AVIONICS FOR AIRBUS AIRCRAFT TESTED

Paris AIR & COSMOS in French 19 Sep 81 pp 34-35

[Article by Gerard Collin: "Flights of the A.300 No 3 with EFIS (Electronic Flight Instrument Systems) and Garuda FFCC (Forward Facing Crew Cockpit) To Take Place Soon"]

[Text] The flight test Airbus A.300 No 3 of Airbus Industrie on last 15 August completed the first phase of in-flight evaluations of 8 months duration which made it possible to test--among other things--the new generation of digital avionics (confirming to ARINC 700) with the immediate objective--the most urgent--of category 2 landing certification for the aircraft before delivery to the Indonesian airline, Garuda, and then to VASP of Brazil. The first A.300 for Garuda should in fact make its first flight about the middle of October and be delivered to that airline in January 1982, thus in 4 months.

To accomplish this the A.300 No 3 was equipped with the digital automatic flight control system--CADV--developed by the SFENA [French Air-Navigation Equipment Company] in collaboration with Smiths Industries and Bodenseewerk. The tests performed with the Airbus No 3 made it possible to explore, under varied conditions (instrument landing system, wind, turbulence, weight, center of gravity) the various CADV modes, to carry out automatic approaches, landings included (more than 70) and 38 manual approaches. Pilots from Airbus Industrie and from French official departments participated in these flights. The Airbus No 3 has gone back into the shop to receive the first pilot's cathode displays developed, in this instance, by Thomson-CSF [Thomson-General Radio Company] and its German partners, VDO-Luft. So equipped, on one side with only cathode displays (therefore, half the instrument panel) the Airbus No 3 should be certified for flight next November.

The airplane will also have the new Garrett GTCP-331-250 APU [auxiliary power unit] which provides a weight saving of 130 kg over the APU of the present Airbus aircraft. This new APU also makes a 23-percent saving in power consumption possible. Several modifications are on a par with this new APU: wiring, structure allowing greater accessibility and easier maintenance, and removal of the electronic fuel regulation unit to a pressurized area.

It is to be noted that this program--a rather extended one--is being fully carried out and is on schedule, which confirms that the new generation of avionics and equipment intended for the A.310 will in fact have been evaluated in flight even before the first flight of the A.310. As for the FFCC design--it is going to fly very soon with the first Garuda airplane, here, too, providing very favorable conditions for the A.310; there will be hardly anything but the wings of the A.310 to receive its airborne baptism next spring....

Substantial Flight Test Facilities on Board

For the Flight tests the Airbus A.300 and A.310 are fitted with an installation for acquisition, processing, and storage of measurement data designed by AEROSPATIALE [National Aerospace Manufacturing Company], general contractor for definition of this installation (the flight tests themselves being conducted by Airbus Industrie). The principal partner of AEROSPATIALE in this matter and supplier of this measurement system is SFIM, with AMPEX as far as the recorders are concerned.

A conventional measurement system comprises several levels: sensors, conditioning (or adaptation), acquisition with PAM (pulse amplitude modulation) multiplexing, digital coding, and utilization (processing, storage in the recorder, or transmission to the ground by telemetry).

As a matter of fact it may be desirable to reverse, somewhat, the sequence of the steps in order to multiplex the data delivered by the sensors before they are conditioned. Actually, conditioning placed upstream from the multiplexing implies that a conditioner be associated with each sensor; but on a development Airbus serveral thousand sensors can be expected! Hence the idea of multiplexing before conditioning by combining into families sensors of the same kind (all synchros, for example) by groups of 8, 16, or 32.

Therein is an evolution underway for the Airbus development airplanes. Another evolution is tied to the flip-flop over digital connections of the new generation avionics (ARINC 700, ARINC 429). Thus, aboard the A.310 the installation "acquires" the major portion of the digital parameters circulating over more than 30 ARINC 429 buses, from which the flight test installation samples only a part of the messages ("labels"). To this we must add that the engines will have available their own box for multiplexing and conditioning their parameters (box designated E-MUX or P-MUX), which reduces somewhat the task of the flight-test installation while contributing to swelling still more the volume of numerical data to be processed.

The total volume of data acquired by the recorder--hence at the end of the system--is considerably increased in the A.310 compared with the original Airbus. The orders of Magnitude are 9,000 words (of 8 bits) per second for the Airbus compared with 30,000 (of 12 bits) for the A.310, or a factor of increase on the order of 5.

Samba, Super-Samba, Sardane

These names were chosen by AEROSPATIALE and the SFIM to designate the three measurement systems used for the Airbus flight tests. All these systems, physically, are in the form of 19-inch rack units, conforming to aeronautical environment standards, and originally designed for the Concorde program. As a rule they are placed inside the cabin.

Samba is the system used at the origin of the Airbus program for the A.300 B2/B4. Moreover it was a Samba system which flew aboard the Airbus No 3 of Airbus Industrie for evaluation of the digital CADV.

It is a SFIM Super-Samba system with Ampex recorders which will fly aboard the first two development A.310 aircraft, processing several thousand parameters.

As for the 3, 4, 5 development aircraft, they will receive Sardane test installations, which are lighter (only several hundred parameters, the bulk of the evolutions having already been effected upon the 1 and 2 airplanes) and more autonomous: this increased autonomy (based upon a Rohlm computer) will facilitate the test program farther along (hot and cold airfields, altitude tests, special runways...). In addition Sardane has recourse to the concept of conditioning after multiplexing as defined above, which lightens the installation.

This brief description of the on-board measurement installations ignores many other aspects; for example, an ideally simple and effective means of validating the system before each flight and identifying every defective part or sensor must be incorporated into the system; this is a difficult problem (several thousand sensors!) which was the subject of numerous development projects on the part of AEROSPATIALE since the early days of the Concorde. The installation also includes peripherals (loading and modification of programs, analog facilities for reading and display of parameters in real time, printers, etc) and, of course, data processing facilities on the grounds for "replaying" and analyzing the flights.

Ampex Recorders

As far as recorders are concerned, it is the American firm, Ampex, chosen by AEROSPATIALE, which has ordered or already acquired model AHBR-1700 and model HBR-3000 recorders. The speed of acquisition is not, in general, the most restrictive factor: typically one megabit per second maximum; Ampex has already exceeded the level of 100 megabands and is aiming at 200 megabands in 1984 and 2,000 in 1988. On the other hand, the specifications for recording life (6 hours) and error rate of 10^{-7} per word (or 10^{-8} per bit) require equipment of very high quality.

The HBR-3000 includes 14 channels recorded at constant density with tape feed rate controlled by the effective input modulation speed. The code is the "Miller square" utilizing an Ampex patent.

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CSO: 3102/16

TRANSPORTATION

BRIEFS

BRITISH PARTICIPATION IN A 320--Aerospace problems occupied a prominent place, especially in talks between Ministers of State Pierre Chevenement and Charles Fiterman and their British counterparts, during the summit meeting in London at the end of last week. The matter of the new 150-passenger, short-medium-range transport plane, the A 320, was discussed, and Mr Fiterman stated that the British have now decided to take a substantial part in the actualization of this project. The ministers are also going to request the industrialists to proceed with the studies and to undertake the talks necessary to work out tentative plans for possible cooperation including the field of engines capable of powering the A 320. This being the case, joint operations already exist involving the industrialists, such as, for example, the agreements between SNECMA [National Corporation for Aircraft Engine Design and Construction] and General Electric on engines of the CFM 56 family, and the intended talks must not disturb this cooperation. Mr Fiterman recalled that an Anglo-Franco-German tripartite conference on the A 320 program is to be held before the end of this year. By then, the industrialists are expected to have submitted their proposals to the governments. These proposals must specifically address the economic viability and the competitiveness of the A 320 project and the timetable dictated by marketing requirements. [Excerpts] [Paris AIR & COSMOS in French 19 Sep 81 p 9] [COPYRIGHT: A. & C. 1980] 9399

END

CSO: 3102/15