5. Post World War II Expansion

Immediately after the war the activities of the laboratory were resumed. Although the laboratory did not incur physical damage during the war, it was not in the best condition, due to lack of funds and materials, the underground activities and the pre-occupation of the personnel with survival during the war period.

The facilities of the aircraft companies, Fokker, Aviolanda, De Schelde, Avio-Diepen and a few smaller organizations had been dismantled or destroyed and much of the machinery had been taken away. The original staff was scattered over the country and abroad.

KLM had carried out transport missions for the Allied Forces during the war and so there was an organization in operating condition. Many of the pilots had escaped to the UK at the beginning of the war. The President of KLM, Mr. Albert Plesman, (1889-1953), [Ref. 31], remained in The Netherlands, initially in The Hague. After having been taken prisoner as one of a group of hostages on 9 May 1941, he was exiled to the East of The Netherlands in April 1942. He stayed at Driene, near Enschede, where the campus of the University Twente is now located. The long time in jail and at Driene gave Plesman ample time to think about the future of 'his' KLM.
Plesman used that time very productively to develop plans for the operation of the airline, managerial and technical concepts and also to contemplate various forms of international cooperation.
After the war he was a founder member of the International Air Transport Association, IATA, a world wide association representing the major regular airlines, promoting air transportation and dealing with a variety of subjects, including standardization and compatibility of equipment.[1] He remained at Driene till the liberation by the Canadian Army in April 1945. As soon as the Canadian Army moved in he made his way to London to take charge of the part of KLM that had been operating for the Allied Forces and started the re-construction of the airline.

Units of the Army Air Force and the Navy Air Service had been actively engaged in the war, mostly as part of, or closely associated with, the (British) Royal Air Force, RAF. These groups formed the core of the new Air Force of the Army (Luchtstrijdkrachten, LSK), which was finally transformed into the Royal Netherlands Air Force, RNLAF (Koninklijke Luchtmacht, KLu) on 11 March 1953.

In the period 1945-1946 there was no doubt about the future of the KLM and the Air Force but it was less clear that the aircraft industry would recover, at least as far as the development of civil transport and military aircraft was concerned. In the light of the enormous progress that had been made in North America and the United Kingdom many felt that the only possible activity for the aircraft industry would be maintenance, repair and possible participation in production or production of complete aircraft under license of other, foreign, manufacturers. The latter did take place and - besides the development and production of a small business plane - soon after the war fighter aircraft were produced under license.

In September 1945 the Government appointed Dr. Ir. Th.P. Tromp (formerly a Director of the Philips Company and Minister of Public Works and Reconstruction during the period in 1944-1945 when

[1] Indicative of Plesman's activities is the recollection of Prof. Van der Neut, [Ref. 28], that Koning, Director of NLL, and he were invited by Plesman to visit him at Driene during the war to discuss the relative weight savings which could be achieved by using larger transport aircraft. During the war period NLL carried out studies for KLM on this and similar subjects in preparation for the post-war period.

the Southern part of The Netherlands had been liberated) as a special advisor to consider the reconstruction of the aircraft industry. Dr. Ir. W.T. Koiter served as his Secretary. Early in 1946 Dr. Tromp invited a few hundred representatives of government, industry, university, etc. for what would now be called a 'hearing'. This helped to convince him that there were interesting opportunities for an aircraft industry with a full design and development capability.

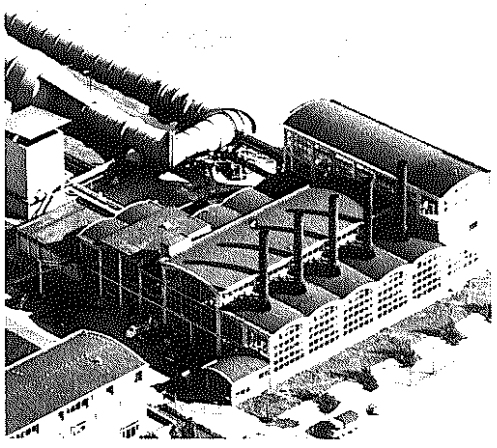
On 14 May 1946 the Government agreed in principle to support the reconstruction of such an industry. A condition of the Government was that closer cooperation should be established between Fokker and some smaller aircraft companies in The Netherlands.
The Government was not well equipped to handle the complicated matter of support to the reconstruction and the development of the aircraft industry and there were also different views within the Ministries concerned as to the form this support should take. Dr. Tromp then proposed to form an intermediate body, a kind of 'trustee' between the Government and the aircraft industry. This body would advise the Government and manage the expenditures of government funds for aircraft development. Thus the Netherlands Institute for Aircraft Development, NIV (Nederlands Instituut voor Vliegtuigontwikkeling) was founded on 19 June 1946. The signatory members were Koiter, Geudeker, Witholt, Jongsma, Gaastra and De Wolff. The Board of this Foundation consisted of representatives of the Government (Ministries, the Air Force and the Navy), the industry, the airline (KLM) and the research sector (universities and laboratories). Dr. Tromp proposed Prof. Van der Maas as the first Chairman and Head of a small executive office. Soon Ir. L.L.Th. Huls (Prof. Van der Maas' second aeronautical engineering graduate) and Mr. G.C. Klapwijk, a lawyer, joined his office, respectively as Technical Assistant and Secretary-Treasurer.

This was a positive development for the NLL.

Encouraged by the Government's intention to promote the design and development of aircraft in The Netherlands, NLL prepared plans to design and construct:

- a high speed (transonic) wind tunnel;
- a scale model of that tunnel (scale 1:5);
- a supersonic blow-down wind tunnel;
- a low turbulence, low speed wind tunnel;
- an extension of general laboratory equipment;
- an extension of the office building;
- a hall for full-scale structural and vibrational testing.

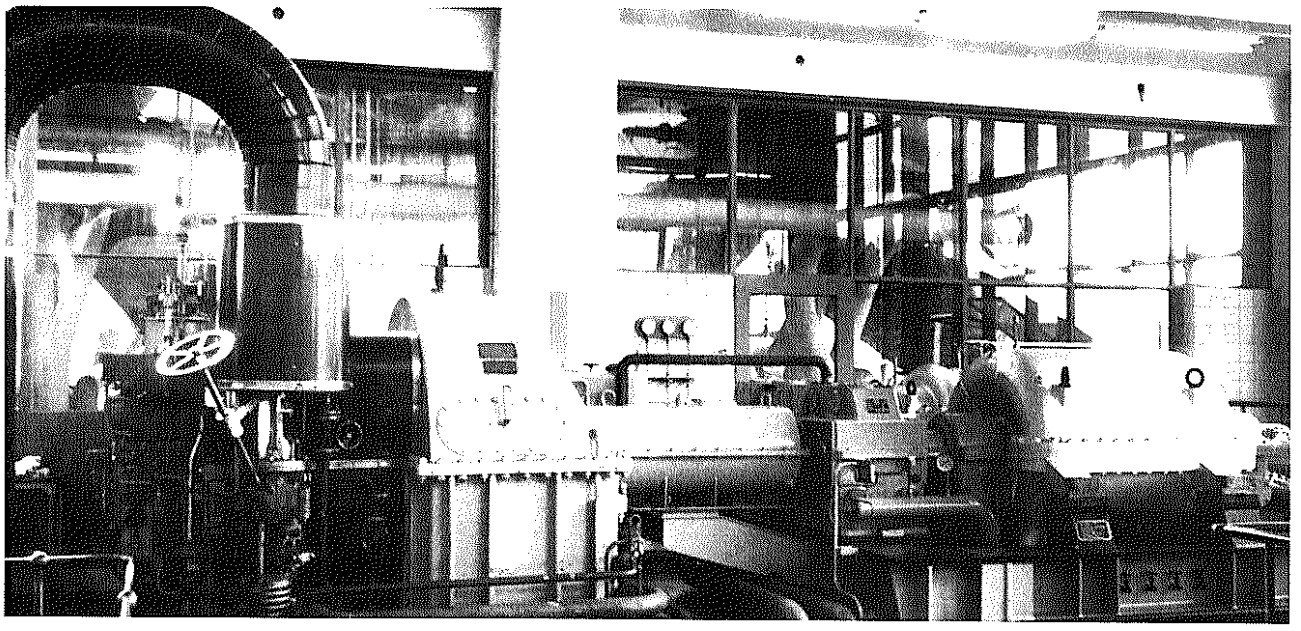
These were ambitious plans. The general positive attitude towards industrialization and the foundation of NIV encouraged NLL to carry on with this expansion plan. The management was strengthened: Ir. A.J. Marx, till then Head of the Flight Department, was appointed in 1947 as Chief Engineer for the whole laboratory to support the Directorate.



Aerial view of the Power Plant at the NLL in Amsterdam, around 1960

When the plans were further detailed during the period 1946-1947 it appeared that the local power company (GEB Amsterdam) was not in a position to supply the electric power of around 20 MW required for the transonic tunnel. The power company would have to extend its plant and special cables would have to be laid. Also, due to the intermittent character of the envisaged wind tunnel operations, this would result in a very high price per KWH. A new power plant at the NLL site, only for the laboratory was also very expensive. The solution was found when, oil-fired, steam turbine power plants of American war surplus escort vessels (destroyers) became available. Six of these units plus spares were bought for the sum of DGL. 300,000. Initially five steam boilers were installed and in 1966 a sixth was added when more power was needed for additional compressors. In 1948 additional spare parts of the H.M.S. Hotham were bought from the UK Ministry of Supply which had had in operation destroyers of the same class. At the end of 1947 a contract

The extension of the Power Plant with a sixth steam boiler and chimney and with a new compressor in 1967



was let to design and construct a turbo-electric power plant utilizing this equipment. At that time Government approval had been obtained for the laboratory expansion and the design of the various facilities was started.

The Crisis

During the course of 1949, when the design had progressed quite far and the construction of the foundations of the facilities had started, the Government re-considered the plans for the reconstruction of the aircraft industry.

It must be recalled that, although the economy was recovering at a satisfactory rate, the Government expenditures had risen to unprecedented levels, not in the least due to the military expenditures in connection with Indonesia, the former Netherlands East Indies.

Immediately after the surrender of the Japanese forces in what was then the Netherlands East Indies, a group of Indonesian leaders, headed by Sukarno and Hatta, declared the independence of

Indonesia on 17 August 1945. Although the policy of the Netherlands Government was, at least in principle, to grant Indonesia gradually more independence and to move into a direction of a union of states, The Netherlands assembled expeditionary forces and ship them to Indonesia to restore law and order. This led to a political and military struggle which ended in 1949 with the recognition of the independent state Indonesia. The financial strain of these actions on the Government budget, still very much burdened by the recovery from the effects of the war in Europe, was enormous.

The result was that on 31 October 1949 NLL was informed that it had to stop all work associated with the expansion plans. After many discussions, the Ministerial Council for Economic Affairs decided on 30 November 1949 that, in principle, it would continue to support the development of aircraft in The Netherlands. However no decision was taken about the NLL expansion plans.

NLL had done its utmost to build up the staff and several important financial commitments had been made in connection with the expansion plans. The laboratory was now in a very difficult financial position.

Apparently the Government saw no direct link between the decision to support aircraft development in The Netherlands and the expansion and modernization plans of NLL. It is possible that the ministers and officials dealing with this matter felt that financial aid to the industry in the form of loans through NIV was a sufficient condition to give the industry a fair chance. It is also possible that it was felt that sufficient laboratory support could be given with the existing facilities. However the Minister of Traffic and Public Works did appoint a Committee to advise him on the organization, the management, the extent of the activities and equipment of the NLL required in the coming years. This Committee was also asked to advise on the need and desirability of the expansion program which had been halted. This Committee, formally charged by letter dated 7 January 1950, consisted of Ir. J. Blackstone attached to the Ministry and Chairman of the Board of the Foundation NLL, Dr. Ir. M.H. Damme, Director General of the PTT and Prof. Dr. Ir. H.J. van der Maas, Professor of Aeronautical Engineering at the Technical University Delft. The Committee went to work immediately and completed its report by the end of March 1950. Many of the thoughts incorporated in the report were the result of debates during the months before the Committee was formed.

This Blackstone-Damme-Van der Maas Report, which became internally known as the **BDM Report**, had a great impact on the operation of the laboratory. The importance of the report was perhaps not that it introduced completely new ideas about the management of the laboratory, but that it analyzed in detail the possibilities and limitations for carrying out aeronautical research in The Netherlands. (The system of financial management proposed in the BDM Report had basically been in operation since the very beginning of the RSL, albeit on a less formal basis when the scale of the operation was smaller.)
The BDM Report recommended in particular:

- *That the annual government subsidy should be abandoned and that the interested parties (NIV, Industry, Defense, RLD, KLM, etc) should supply an equivalent amount on a contractual basis. This sum should be guaranteed and the contractors should indicate their priorities.*
- *That amortization (including interest) should not be included in the rates applied for the usage of equipment and installations (including buildings, small equipment, etc. for which no separate rates existed) and that a special Government annual subsidy should be given to NLL to cover these costs. These subsidies could be used to create an investment fund.*
- *That a government subsidy should be made available for basic research (not earmarked for a particular application) amounting to 10% of the income received from contracts.*
- *That the original expansion plans should be executed with some adjustments and reductions.*

At the beginning of 1950 the Board of NLL had approved the budget for that year, which was submitted to the Government, assuming that the recommendations of the BDM Report would be accepted. However by mid-1950 the Minister informed the Board that no decisions had been taken yet concerning the expansion of the laboratory and that in any case measures should be taken to reduce the personnel cost substantially in view of the expected financial shortfall in the budget. The Board then had to decide to reduce the number of personnel drastically. This led to a crisis in the Board and the vast majority of the members proposed in a meeting on 30 August 1950 that the Board should resign and that the members hand in their resignation to the Ministries and organizations which had appointed them, in order to create the possibility to form a new Board. The Board then resigned.

It should be noted here that there was no direct representation of the aircraft industry on the Board. In fact there was no aircraft industry representation on the Board during the period 1942-1954. The airline (KLM) was continuously represented.

During the last quarter of 1950 a new Board was formed which held its first meeting on 5 December 1950. The Board proposed Prof. Van der Maas as its new Chairman and on 27 December 1950 he was appointed as such by the Minister of Traffic and Public Works. Prof. Van der Maas now came into the unique position of heading the Aeronautical Engineering Department (then still a Sub-Department of the Department of Mechanical Engineering but soon to become a separate Department) of the Technical University Delft, the NIV (the Netherlands Institute for Aircraft Development) and the laboratory NLL. It was the beginning of a period of more than 25 years of very fruitful aerospace development in The Netherlands to which Prof. Van der Maas contributed enormously through these key positions.

It still took more than two years before the political climate became more favorable for NLL. The laboratory was faced with a great problem. For an engineering research laboratory such as NLL, where preparations extend over many years before actual project support can be given, such a long delay was disappointing.

Severe measures had to be taken. In 1949 the number of personnel was reduced by 15 through natural attrition but in the middle of 1950 the Board had to decide that a further 59 employees had to be released before the end of 1950. Such measures had a disastrous effect on the morale of the personnel, particularly in a time frame when there was a general shortage of technical personnel in the country. In fact by the end of 1950 there were 204 employees, compared to 304 early in 1949. A reduction of the personnel by one third in about one year is very serious indeed. The reduction was equally divided among the various personnel categories. For many years, even to this date, this shock effect led to a very cautious hiring policy for permanent personnel. Another effect was that when it was again possible to hire new personnel, it was difficult to attract suitable personnel, so badly needed for the expansion plans and the growing number of contracts.[2]

The recommendations of the BDM Report were finally approved by the Government on **3 March 1952**. The interruption had lasted **28 months**. This delay was caused to a large extent by the financial problems of the Government but there was also another important factor involved. The foundation of NIV in 1946 was a positive step but it did not guarantee the viability of the aircraft industry. Many leading politicians wanted to be assured that an aircraft industry with its own design and development capability could survive. It was not till early in 1952 that this appeared to be a reasonable gamble.

A major change was that, as a result of the critical years, the Board of NLL, through the office of the Chairman took a far more active part in the planning and decision making process. In 1953 it was decided to establish a small office at Delft to assist the Chairman. The staff included

[2]After the Government approval had been given, Prof. Van der Maas, through his unique position, urged promising students in the 1950's to take up employment at NLL before they had completed their studies. They graduated while working at NLL and several of those later made up the backbone of the engineering and research staff of NLL.

Mr. G.C. Klapwijk (who was also Secretary-Treasurer of NIV and who later became Chairman of the Board of Fokker and also of the Holding Company VFW-Fokker) who served as Secretary-Treasurer of the Board, Ir. J. Boel (who later moved to the laboratory and became Deputy Director during the period 1967-1971) for technical matters and Mrs. M.J.M. Janson-van Wijk (till that time Head of the Administration at the laboratory in Amsterdam) for administrative matters.
With the approval of the BDM Report, NLL was given a new lease on life. The cost of carrying out the modified expansion plans was estimated at DGL. 26.1 million. The completion date given in the report of early 1950, was optimistically estimated as sometime in 1953. Obviously that date had to be adjusted. At the time of the interruption a total of DGL. 9.7 million had been committed of which DGL. 8.45 million had been paid at the resumption of the activities in 1952. The Power Plant was in an advanced state of construction and the foundations of the new wind tunnels had been constructed.

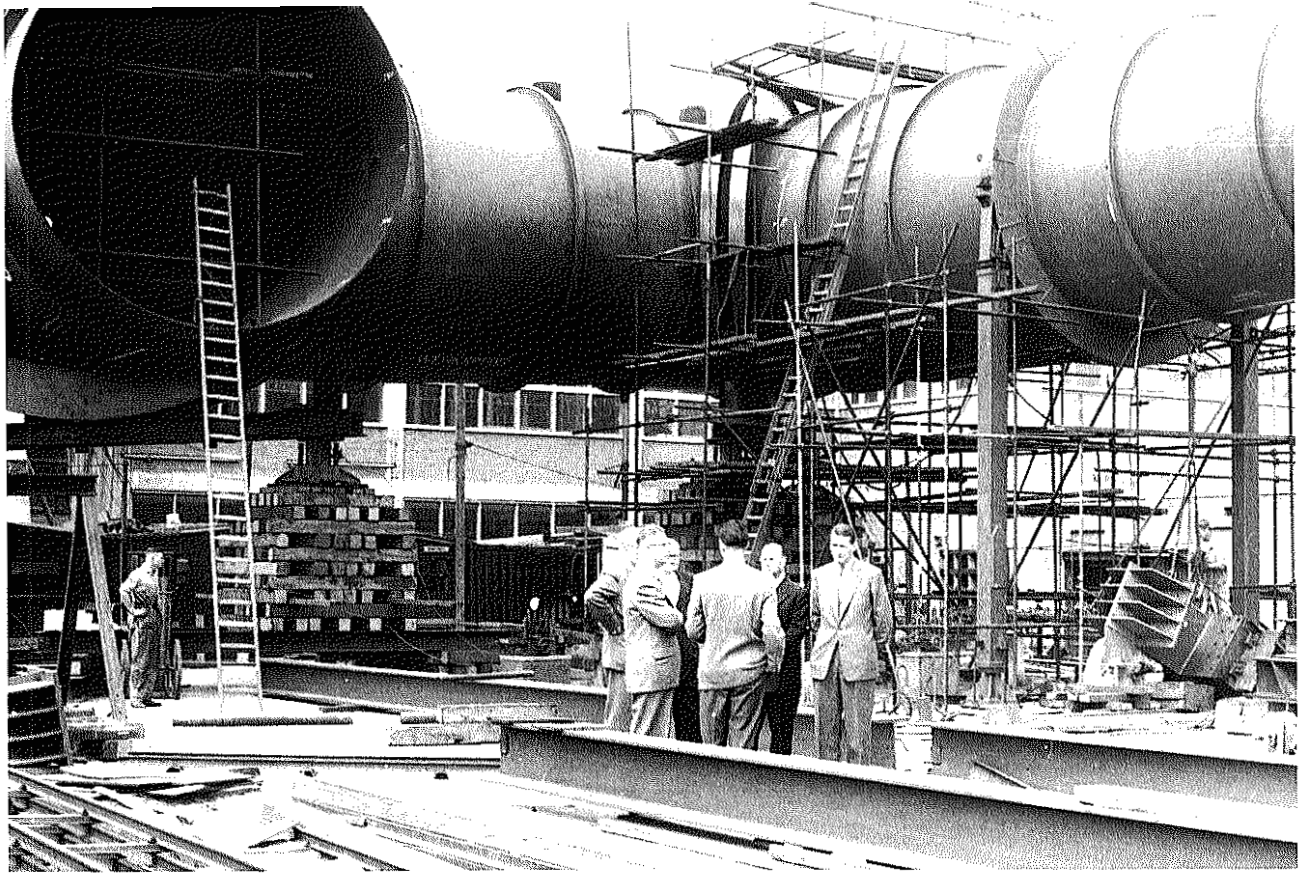
The changes in the plans were that the construction of the low speed low turbulence tunnel[3] and the construction of the hall for vibrational and structural testing at Schiphol were canceled. One reason for the latter was probably that it was realized that for the real long term the site at Amsterdam would not suffice and that a second laboratory site had to be found. Facilities for structural testing could then be located at this new site.
There were also many detailed technical changes particularly for the high speed tunnel (HST). In the original plan of the HST (1947-1949) the aim was to achieve a maximum Mach Number in the test section between 0.85 and 0.90, which was the highest Mach Number attainable with a conventional, solid wall, test section.
When in 1952 the construction plans were taken up again it was known to NLL engineers that it was possible to build a test section which would accommodate a flow with Mach Number larger than one, a true transonic test section. Although few details of the new transonic testing techniques, developed elsewhere, particularly in the USA, were known, a re-design of the test section of that wind tunnel was undertaken with the assistance of a Swiss firm. It became a test section with longitudinal slots in the top and bottom walls of the test section and a plenum chamber around the test section - a 'ventilated' test section.

Dr. Th. von Kármán, Chairman of AGARD, wrote the following story about the HST transonic test section, [Ref. 32]:

> *-"They (NLL) planned a large wind tunnel going up to the speed of sound. Transonic speeds were unattainable with design methods available in the open literature because of a phenomenon called 'choking'. During the war, however, John Stack and his group working for the National Advisory Committee for Aeronautics in the United States had developed a transonic 'throat' which made possible wind tunnel operation in the important region just above the speed of sound. Unfortunately, this information was still classified and unavailable to The Netherlands. The Dutch scientists spoke to me about it, and I agreed that it would be a waste for them to build an expensive obsolete wind tunnel when there was an urgent need on the Continent for data in the new speed region. I urged NACA to declassify the material, but I was told the process would take quite a while.*
> *I couldn't help but believe that there was a way around this silly red tape, and it occurred to me that some Swiss engineers knew the principle of the transonic throat because they had been working in the United States on it before the method was classified.[4] Since the Swiss were unhampered by*

[3]The large concrete foundation of the low speed low turbulence tunnel in the middle of the NLL laboratory site became known among the personnel as the King's Tomb (Koningsgraf, perhaps referring to the Director Koning). It resembled the coffin of a giant king. During the late 1960's an office building was constructed on this foundation.

[4]Note by the author: Actually the idea of a 'slotted' test section could be traced to early theoretical work of Prandtl and Glauert in Germany during the 1920's and a very specific configuration suggested by Wieselsberger in Germany in 1942, [Ref. 15].

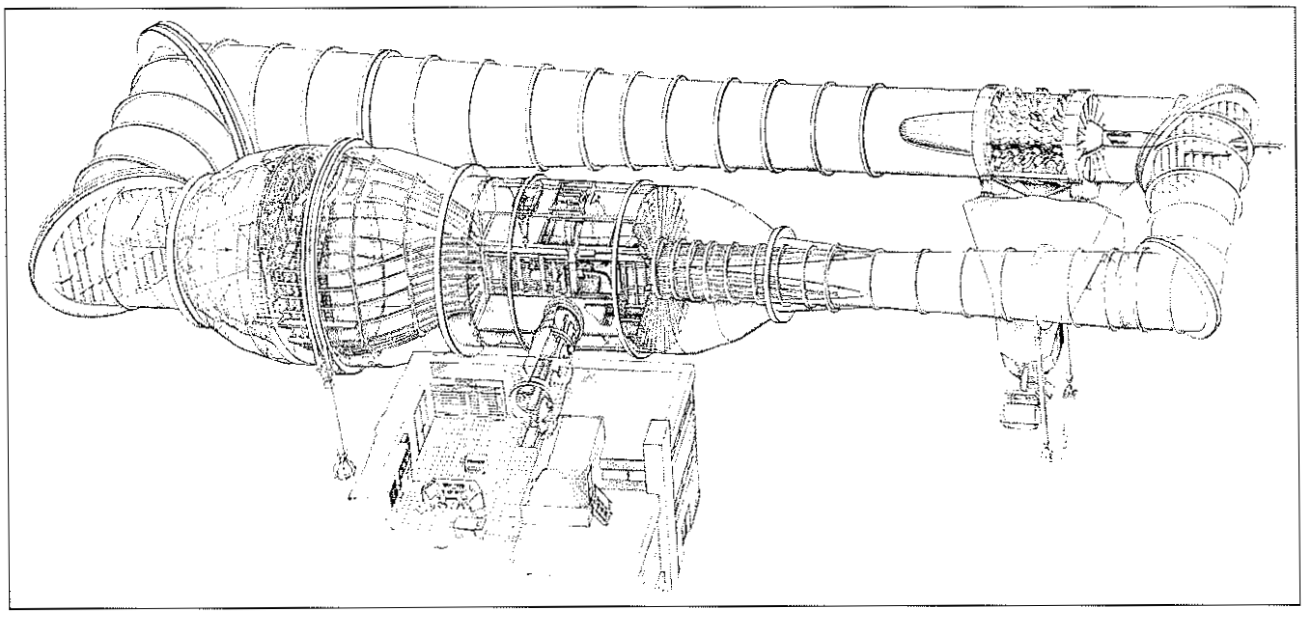


The High Speed Wind Tunnel HST under construction around 1956

NATO agreements, however, they were free to help The Netherlands. The drawback was that the U.S. research had progressed considerably since the Swiss left the United States. To overcome this gap I inquired in the United States whether it was possible for American engineers to criticize the designs of our NATO partners, even if they were not allowed to pass out information on U.S. designs. The authorities said this was possible, so I arranged for U.S. experts to visit The Netherlands and constructively criticize Dutch drawings of designs based on Swiss information.
This worked. Instead of a 'lemon' The Netherlands has one of the best facilities on the Continent and has made outstanding contributions to the design of European aircraft."

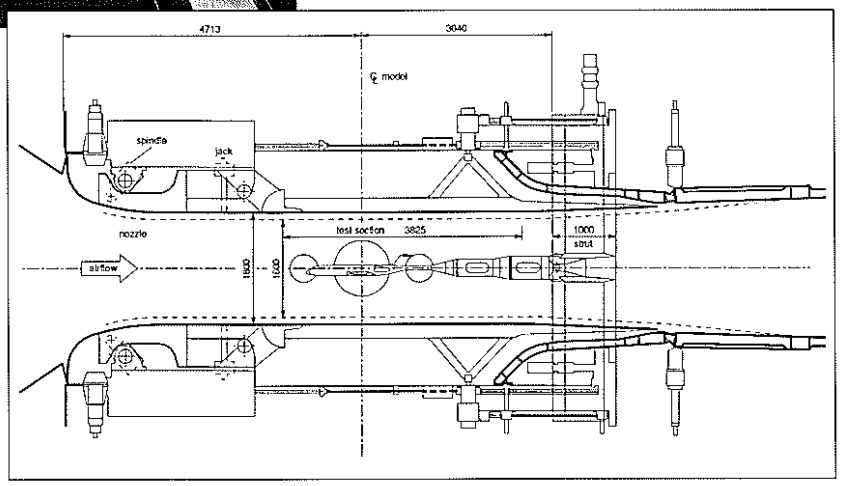
Sketch of the High Speed Wind Tunnel HST, as it was built

Starting from this 'Swiss design' the adjustable throat ahead of the test section, the test section itself and the second throat after the test section were further developed and the HST is now indeed a superb transonic wind tunnel.



The High Speed Wind Tunnel HST completed

The latest modifications, completed in 1992, include adjustable top and bottom test section walls - from 2.00 x 1.60 M^2 to 2.00 x 1.80 M^2 -, a new model support system, modification of the control system and data handling system.



The new test section, with increased length and variable height, of the High Speed Wind Tunnel HST, 1992

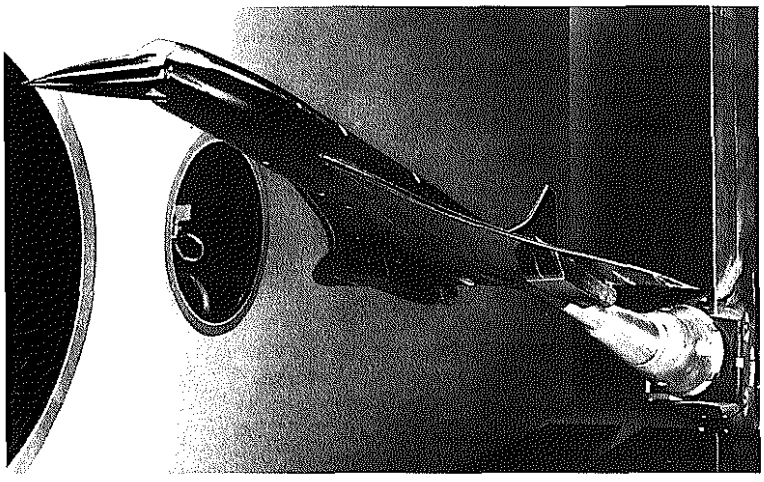
An International Encounter

One of the annexes of the BDM Report was a letter (dated 10 February 1950) of Prof. Maurice Roy, the Director of ONERA, the Office National d'Études et de Recherches Aéronautiques (the French Aeronautical Research Organization), to Ir. C. Koning, the Director of NLL, indicating ONERA's interest in some form of cooperation with respect to the variable density transonic tunnel under consideration at NLL. The French interest in the project was used in the BDM Report as supporting evidence for the NLL plans. In retrospect it is difficult to determine how much influence this had on the final decision of the Government to approve the plans. It may not have been important for the direct decision, but it was the beginning of international cooperation and 'cross utilization' of facilities.

In January 1950 Mr. R.A. Willaume[5] of ONERA visited NLL and discussed the wind tunnel plans of NLL. In France ONERA was involved in a large construction activity at Modane-Avrieux in the French Alps. The major wind tunnel under construction was a high speed wind tunnel with a test section diameter of 8 M. This facility originated in Germany during the Second World War and was under construction at Ötzal, Austria, at the end of the war.[6] The plans of ONERA also included a transonic tunnel with a test section of approximately 2 M^2. However France was also faced with financial limitations and ONERA realized that the plans to construct a transonic facility might be retarded. That must have been Prof. Roy's motivation to explore some form of cooperation with NLL. In return he could offer the use of the large 8-Meter high speed wind tunnel at Modane.

[5]Mr. Willaume's trip report of January 1950 was made available to the author by IGA M. Benichou, President of ONERA.
Mr. Willaume was External Relations Officer at ONERA. Later he joined Dr. Th. von Kármán when AGARD was established in Paris. He served as AGARD's Director of Plans and Programmes during the period 1952-1980 and assisted Von Kármán and Wattendorf, respectively Chairman and Director of AGARD, in the liaison with the French authorities. Through his position at AGARD he was also instrumental in assisting in the cooperation between several other countries.

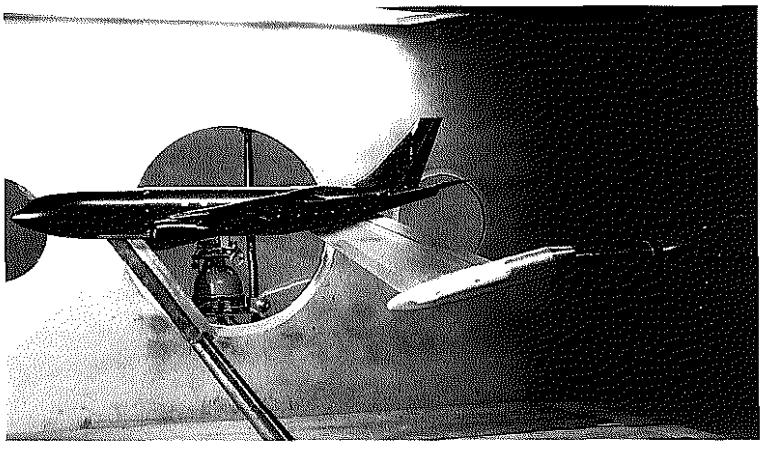
[6]The highly interesting story of the transfer to France of this facility and the subsequent construction of the facilities at Modane was described by Marcel Pierre who was the engineer in charge of the development at Modane, [Ref. 33].



A model of the French-British Concorde in the High Speed Wind Tunnel HST

At that point in time (1950) no further progress in international cooperation could be made since NLL had not received government approval to proceed with its expansion plans. However some time later, at the end of 1953, the Association Internationale des Constructeurs de Matérial Aéronautique, AICMA, (European Association of Aircraft Manufacturers), established the Commité Internationale Permanent des Souffleries, CIPS (Permanent Committee on Wind Tunnels). This Committee made an inventory of the need for development facilities in Europe and on 26 March 1954 a meeting was held at the Paris' office of AICMA. The CIPS representatives discussed with Prof. Van der Maas and Prof. Zwikker (who then was the Director of NLL) a proposal for the utilization of the HST which was then under construction and also for the supersonic tunnel, the SST which was in the design stage. On 9 and 10 April 1954, during a meeting in The Netherlands, various modes of cooperation were further discussed with representatives of some aircraft manufacturers. Finally these discussions led to the signing of a contract between AICMA-CIPS and NLL, which stipulated that NLL would make available the HST to members of AICMA for up to 50% of the available testing time. This contract, signed on 23 February 1955, included details about the minimum occupancy by AICMA members, AICMA fees, the principles of the wind tunnel charges and details on the reservation of testing times.

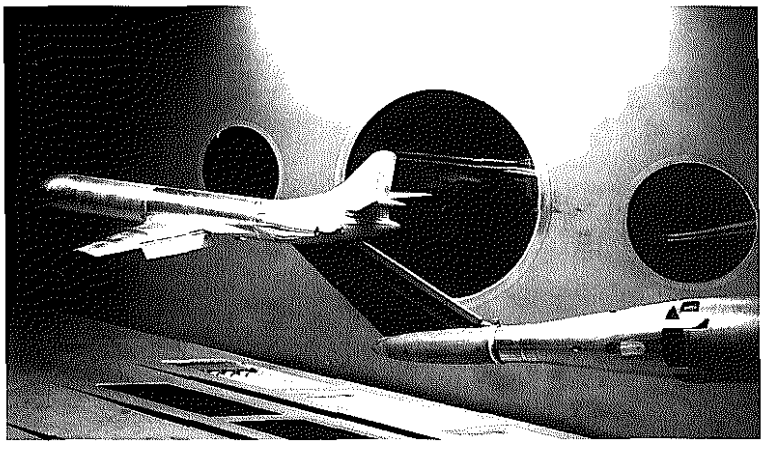
A model of an Airbus in the High Speed Wind Tunnel HST



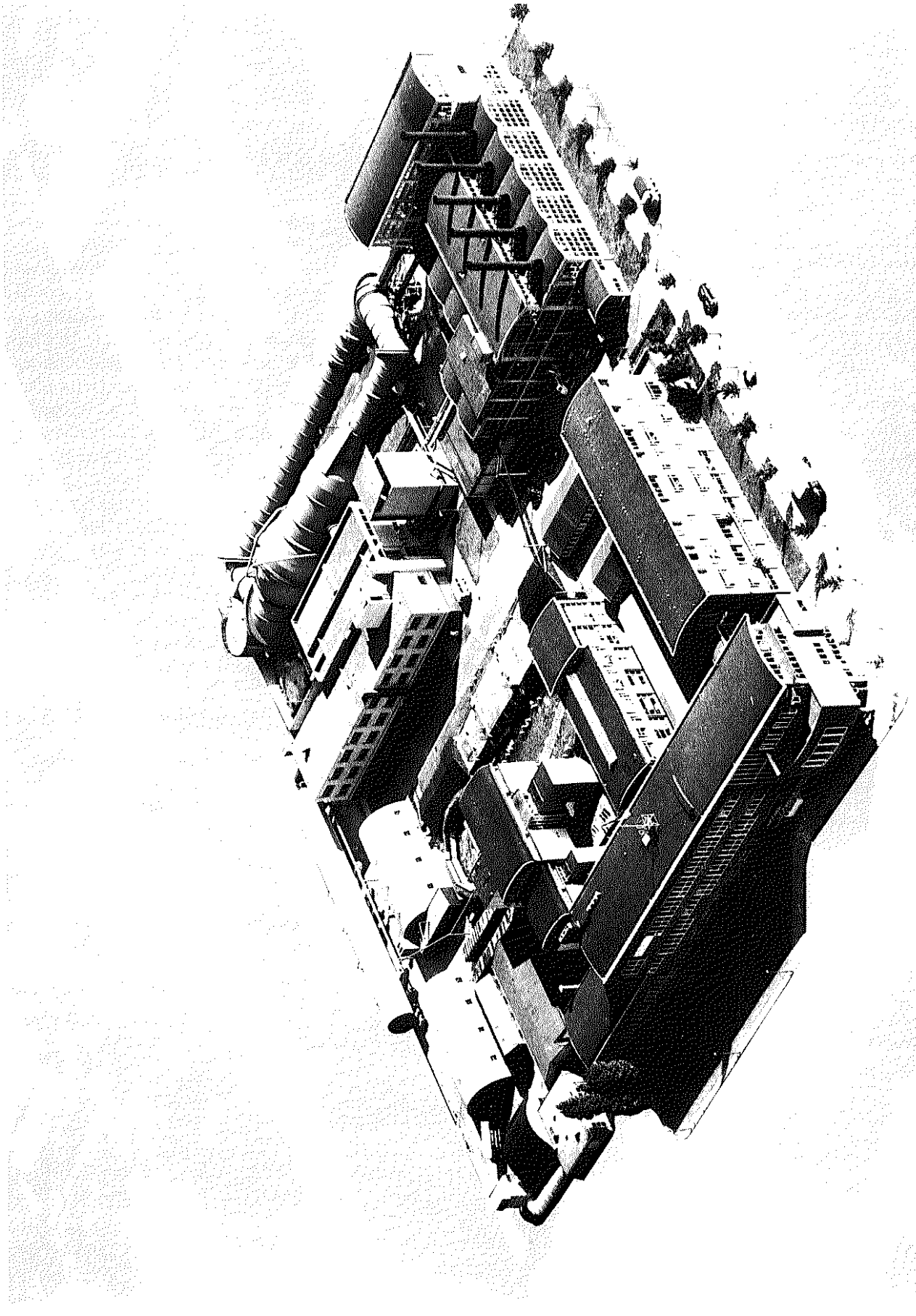
During the following decades this agreement resulted in a very fruitful utilization by various AICMA members of the HST and later also of the SST. It also served as a stimulant to further cooperation across the borders although this was a rather slow process.

The participants in the CIPS planned to go much farther and their plans included a large blow-down facility, with a 3 x 3 M^2 test section, for up to Mach Number 3 and suitable for engine tests at supersonic speeds. In the period 1956-1958 the French company SESSIA built an 0.85 x 0.85 M^2 pilot facility, with a high pressure (65 atm.) hot water (270°C) injector after the second throat.

A model of the Caravelle in the High Speed Wind Tunnel HST



Aerial view of NLL in Amsterdam around 1960 with the uncovered High Speed Wind Tunnel HST in the rear



Members of the Board, Directorate and Staff of the NLL, 1959

It was hoped that at least five countries would participate in the full-scale facility. It was apparently too early.

Since the 1950's many cooperative aerospace projects were carried out in Europe whereby companies of different countries worked together closely during the design, development and manufacturing stages. However it was not till 1976 when a two-nation (Germany and The Netherlands) aeronautical test facility, the DNW, (Chapter 18), became a reality, and it took till 1988 when finally a four-nation (France, Germany, the UK and The Netherlands) aeronautical test facility, the ETW, (Chapter 19), was started.
The best that could be achieved in the 1950's in the area of cooperation in planning and operation of facilities was the AICMA/NLL-contract.