

ACTIVITIES OF THE LTA COMMITTEE OF THE GERMAN AEROSPACE SOCIETY DGLR

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Abstract

The LTA Committee of the Deutsche Gesellschaft für Luft- und Raumfahrt (German Society for Aeronautics and Astronautics) was founded in 1974 and has consequently conducted several detailed studies on the economy of large airship carriers and on the viability of airships to be used as research platforms in various scenarios. The Committee then followed a strict policy of technical and economic viability, i.e. to be as innovative as necessary and to be as conservative as possible.

The German reunification coincided with an era of renewed interest in LTA technology with a variety of new technologies, projects and interdisciplinary research aspects. The Committee, now augmented by a group of East German scientists and engineers, has assumed the initiative to collect the representatives of the various activities in annual conferences since 1993, in most cases extending over two days.

The topics covered may be categorized in the following manner:

- general technology analyses
- economic and operations analyses
- presentation of new concepts and projects
- experimental data
- balloon technology
- interdisciplinary research (bionics, zoology etc.)
- unmanned vehicles - propulsion, guidance and control
- analyses concerning on-going problem areas
- history, personalities etc.

It has been noted that, in many cases, the conference gave the opportunity to present progress reports on current projects. Moreover, according to DGLR policy, students and junior engineers is given the opportunity to report on their ongoing projects. Particular aspects of economic and operational interest are e.g. heavy cargo transportation, maneuverability and ground handling, surveillance and research platforms, advertising and tourism .

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In addition, the potentials of unmanned airships have attracted special attention,

1. Introduction

The history of the German Society for Aeronautics and Astronautics DGLR (Deutsche Gesellschaft für Luft- und Raumfahrt - Lilienthal-Oberth e.V.) began more than 80 years ago on April 12th, 1912, in Berlin with the foundation of the Scientific Society for Flight Technology (Wissenschaftliche Gesellschaft für Flugtechnik), which later transformed into the Scientific Society for Aeronautics and Astronautics WGLR (Wissenschaftliche Gesellschaft für Luft- und Raumfahrt). The activities of both the WGLR and the German Society for Rocket Technology and Spaceflight DGRR (Deutsche Gesellschaft für Raketentechnik und Raumfahrt) have then been combined by the foundation of the DGLR.

With the objective to provide a common voice encompassing all aerospace-dedicated individuals with a more effective impact on public opinion, the DGLR has merged on July 27th, 1993, with further historic and professional societies and has assumed the official name

Deutsche Gesellschaft für Luft- und Raumfahrt - Lilienthal-Oberth e.V.

thus including the names of the two spear-heading renown German aviation and astronautics pioneers Otto Lilienthal (1848-1896) and Hermann Oberth (1894-1989).

Prominent members, honorary members and award winners of the DGLR are for instance:

Dr. Ludwig Bölkow, Wernher von Braun, Prof. Dr. Claude Dornier, Prof. Dr. Henrich Focke, Dr. Reinhard Furrer, Sir Frederick Handley Page, Prof. Dr. Dr. Theodor von Kármán, Dr. Ulf Merbold, Prof. Dr. Ernst Messerschmid, Dr. Hans J. Pabst von Ohain.

The DGLR thus offers a broad spectrum of in-depth education and exchange of experience to all members.

2. Organization of the DGLR

2.1 Board of Directors

The present Board of Directors has been elected for a period of 1 Jan 1998 thru 31 Dec 2000. The functions and responsibilities are as follows:

- 1st Director: Prof. Dr.-Ing. Hans J. Rath
 Direction and control of the activities of the Society, national and international cooperation with science, industry and politics.
- 2nd Director: Dr.-Ing. Rolf Stüssel
 International cooperation in CEAS matters, representation of the DGLR in the CEAS Council.
- 3rd Director: Dipl.-Ing. Bernd Ossenbühl
 Organization, treasurer, soliciting of new members.

Further Members of the Board of Directors:

- Prof. Dr.-Ing. Uwe Apel
 Regional sections, students groups, students education and support, DLGR homepage.
- Dipl.-Ing. Klaus Berge
 Professional sections, commissions, conventions, DGLR representative at the IAF, public relations.
- Dipl.-Ing, Dipl.-Wirtsch.-Ing. Reinhold Falthäuser
 National and international cooperation regarding defence and procurement, public relations.
- Prof. Dr.-Ing. Dieter Schmitt
 Professional sections, commissions, annual conventions.
- Dr.-Ing. Joachim Szodruch
 Students rewards, publications.

Commissioners of the Board of Directors:

Prof. Dr.-Ing. Boris Laschka
 ICAS matters, president of the Honor Awarding Committee

Prof. Dipl.-Ing. Gero Madelung
 RTO matters (formerly AGARD)

Prof. Dr.-Ing. Fred Thomas
 Aerospace Science and Technology

Secretary General: Hans Lüttgen

2.2 Committees

The individual committees are subdivided in two major groups, i.e. technology and subsystem oriented committees and those oriented toward systems.

2.2.1 Technologies and Subsystems

Subsequent committees are specialized on particular subjects concerning:

- T1 Structures
- T1.1 Material Strength and Design
- T1.2 Aeroelastics and Structural Dynamics
- T1.3 Materials
- T1.4 Manufacturing
- T1.5 Computer Aids
- T2 Fluid and Thermodynamics
- T2.1 Aerodynamic Theory
- T2.2 Experimental Aerodynamics
- T2.3 Combustion
- T2.4 Flow Acoustics
- T2.5 Experimental Facilities
- T3 Propulsion
- T3.1 Turbines
- T3.2 Rockets and Ramjets
- T3.3 Electrical and Unconventional Propulsion
- T4 Energy Supply/Protective Systems/Automation
- T4.1 Energy Supply
- T4.2 Thermal Control and Life Support Systems
- T4.3 Automation and Robotics
- T4.4 Technology of Computer-Supported Simulation
- T5 Flight and Orbital Mechanics
- T5.1 Flight Performances (including RVD and Reentry)
- T5.2 Flight Properties
- T5.3 Flight Control and Navigation
- T5.4 Human Engineering
- T5.5 Flight Test Technology
- T6 Electronics and Informatics
- T6.1 Telemetry
- T6.2 Avionics
- T6.3 Information Transfer and Signal Processing
- T6.4 Sensors/Data Reception
- T6.5 Computer Technology
- T6.6 Software Engineering

2.2.2 Systems

The committees of this category are representing the following systems:

- S1 Systems Engineering
 - S1.1 Project Management
 - S1.2 Quality Management and Assurance
 - S1.3 Systems Analysis and Assessment
 - S1.4 Innovation Management
- S2 Aviation Systems Development, Manufacturing and Operation
 - S2.1 Fixed-Wing Systems
 - S2.2 Helicopter Systems
 - S2.3 Flight Systems Lighter Than Air**
 - S2.4 Air Traffic Corporations
 - S2.5 Flight Control Services
 - S2.6 Airfields
 - S2.7 Flight Economy
- S3 Aerobody Systems Development, Manufacturing and Operation
 - S3.1 Projectiles and Ballistic Aerobody Systems
 - S3.2 Missile Systems
 - S3.3 UAVs/RPVs
- S4 Space Flight Systems Development, Manufacturing and Operation
 - S4.1 Space Transport Systems
 - S4.2 Scientific Satellites and Space Sounds
 - S4.3 Commercial Satellites
 - S4.4 Orbital Infrastructures
 - S4.5 Ground Facilities
 - S4.6 System Aspects of Manned Spaceflight
 - S4.7 Orbital Environment and Space Simulation
- S5 Utilization and Applications
 - S5.1 Space Research
 - S5.2 Earth Observation and Environmental Surveillance
 - S5.3 Research under Space Environment Conditions
 - S5.4 Communication and Navigation
 - S5.5 TBD
 - S5.6 Martian Exploration and Research - Mars Society German Chapter
- S6 Aeronautical and Space Laws
- S7 History of Aeronautics and Astronautics
- S8 Information and Documentation

3. History of the LTA Committee

3.1 Genesis

Except for a few private clubs on Lighter-Than-Air and small advertising airships, there was practically nil interest in the aeronautical world in Germany in the field of airships during the Fifties and Sixties. Then political impact was produced by a Dutch engineer, Gerhard Hoffmann. In the Thirties, Hoffmann was involved in the route planning for world-wide zeppelin operation, in particular establishing an airship line from the Netherlands to Indonesia, still a Dutch colony at that time. The progress made during that time was promising, until the Lakehurst event brought all plans to a halt.

Hoffmann strongly believed in the resurrection of zeppelin operation after WW II and proposed the reconstruction of a modern "Bodensee", a small zeppelin originally built in 1919 which eventually turned out to be the first "airbus" between two cities, i.e. Friedrichshafen and Berlin, with an extension to Stockholm. This proposal, however, stipulated financial support by the Zeppelin Foundation in Friedrichshafen which - according to the will of Count Zeppelin - should dedicate the annual interests to the development of airships. As a consequence, a legalistic battle started, thus making Hoffmann a "persona non grata" in Friedrichshafen, because since after WW II, the City of Friedrichshafen remained to be the main beneficiary of the annual dividend of the Zeppelin Foundation.

In the meantime, Hoffmann had created the concept of a "Olympia-Zeppelin" for the Olympic games 1972 in Munich. In combination with a strong plea in favor of a national airship program, Hoffmann presented his arguments to the President of the Federal Republic, Gustav Heinemann, who, in turn, transferred the entire matter to the recently founded DGLR for further action and processing.

3.2 DGLR Airship Symposium I, II and III

The DGLR took action and organized in 1972 and 1973 three consecutive symposia in Stuttgart, Zeppelinheim and Mülheim. The plenum comprised a confusing mix of scientists, engineers, LTA buffs, zeppelin veterans and - last not least - "inventors" with atomic super-airships having revolutionary new aerodynamic laws for higher propulsion efficiency.

In retrospect, the overall outcome was absolutely insatisfactory. The Mülheim Symposium, though, had a special touch, since it took place on the premises of the "Westdeutsche Luftwerbung", where Theodor Wullenkemper had just started his own airship production with colored night signs a few years before.

Under the impression of real airships in the hangar, the "fancy" section of the plenum remained silent, while a board was established, comprising representatives of Lufthansa (air) and Hapag-Lloyd (sea) to discuss the reintegration of transport airships in the present traffic scenario. However, no viable answer was found, primarily due to the fact that no real project was in sight.

3.3 Establishment of the LTA Committee

It had become clear to the DGLR that no further progress could be achieved without disciplining the heterogeneous group of interested individuals. The DGLR had already started to establish a system of technical committees for efficient specialization (see section 2.2); hence, an aeronautical engineer, Werner Wilke, was assigned in May 1974 to organize an LTA-dedicated committee to provide professional working conditions.

Chairman became a down-to-earth marine technician and economist, Wolfgang von Kirschbaum, who was immediately confronted with the problems of task definitions and group structuring. It became clear that a considerable number of concepts and projects had been publicized at that time, but 70 per cent lacked fundamental data to be considered serious. Therefore, a policy of "small steps" was agreed upon and a work breakdown structure was devised to assign specific topics to competent specialists according to the subsequent scheme [ref 1]:

1. Technology
 - Design and Materials
 - Energy supply, propulsion, lift, ballast
 - Surveillance, control, flight mechanics
 - Static and dynamic properties
 - Operations, handling, safety, utilization
2. Manufacturing and assembly
3. Missions: research, emergencies, commercial
4. Costs, operating economy
5. Information transfer, literature

The routine committee activities were defined to be cooperation with prospective users and industry, the dissemination of information, organization of conferences, and the observation of LTA activities abroad.

3.4 Initial Activities of the LTA Committee

The activities in particular concentrated on the following tasks:

- Definition of a state-of-the-art technical concept
- Economy and mission potentials
- Analysis of commercial potentials and demands

To organize professional activities within the still heterogeneous group, von Kirschbaum initiated a program to investigate the potentials of a "Hindenburg"-size transport airship and assigned specific detail tasks as homework for the respective following sessions. It became clear that real calculations and carefully written analyses on professional basis turned out to be a real horror to most fast-talking and insistent "inventors" and self-assigned promoters, - and the number of committee members reduced itself to a professional kernel of engineers, analysts, economists and experienced operators such as Alfred Zeuse, former navigation officer onboard of "Graf Zeppelin".

The outcome of these efforts was documented in a comprehensive volume "Investigation of a 200,000 m³ Rigid Airship with Regard to the Contemporary State-of-the-Art", dated 31 March 1976 [ref 2]. The resumé of this report was:

- (1) A comprehensive collection of detail data,
- (2) proof of feasibility to design and construct a large rigid airship in accordance with the state-of-the-art of the aeronautical industry at an acceptable cost level,
- (3) trend analyses regarding a 400,000 m³ airship with respect to decreasing transportation costs.

At the time of the conclusion of the first report, several new aspects influenced the further activities: the Heavy Lifter concepts in the USA and a project supported by the Federal Ministry of Economic Cooperation to provide an airship for developing African nations to alleviate inherent infrastructure problems.

While the Heavy Lifter, as promoted by Goodyear and Piasecki's "HeliStat", drew the attention to the potentials of hybrid systems, the "Africa expedition" caused an upheaval of controversies: Optimists already saw the entire cocoa crop being airlifted from the interior of the country to the coast, although the only airship available at that time was Wüllenkemper's 6000 m³ advertising blimp, which was packed and brought to Ghana by airfreight (!). A section of the German Research and Test Institute for Aeronautics and Astronautics DLVLR (today renamed DLR) was contracted to execute a test program in order to determine, whether airship operations are feasible in the tropical zones or not. The LTA Committee was - of course - not involved; the Ministry obviously did not know about the existence of such a group of experts.

When, too late, members of the Committee were invited by the Ministry for consultation w.r.t. the DLVLR test program. The reply to the responsible officials, whether they knew that a zeppelin had already operated in tropical zones in 1931 in the course of regular airline services, came as an unexpected shock. Moreover, the budget for this expedition had already been overdrawn by several million DM, and the flaming sword of the Bundesrechnungshof (Federal Controller General) was dangling over the heads of the responsible project officers.

The overall result of the African affair could be summarized as follows:

- A successfully conducted flight and test campaign with good documentation of test data and technical reports.
- A negative report on the aspects of airship transportation economy.
- Substantial loss of credibility due to Wüllenkemper's unreflected trend and feasibility projections during the campaign.
- A project budget overdraft with the effect that, within the ministries, the airship had become a horror vision - career-wise.

3.5 The Research Airship

As an immediate consequence, the Committee had to react to limit the harm being done to the cause of airships. From a realistic point of view, for instance, it did not appear to be practical to restart airship carrier construction at the size of the "Hindenburg". Therefore, the concept of research airships of lesser sizes for multiple applications was investigated. Von

Kirschbaum initiated a questionnaire campaign to numerous German research institutes concerning their specific requirements. The response was quite promising. In the course of an evaluation of the questionnaires, three airship types were defined, depending on the respective demands and requirements:

- (1) 6000 m³ - blimp
- (2) 16,000 m³ - rigid (sub-size "Bodensee")
- (3) 70,000 m³ - rigid ("Los Angeles"-type)

The analysis was documented in an interim report, dated 31 March 1978 [ref 3], and all efforts were made to organize another DGLR-Airship-Symposium in October 1978 in Bonn, with high hopes that influential politicians and representatives of relevant ministries may attend this symposium. The result after all careful preparations was discouraging, although most papers and presentations had been of good quality and technical standard and the number of attendants looked promising, none of the invited officials appeared.

On the other hand, there was a frustrated Wüllenkemper complaining about press attacks on account of the African campaign. Moreover, numerous already forgotten species of the notorious league of "inventors" and self-assigned promoters reappeared and occupied substantial time for lengthy discussions.

In the aftermath, von Kirschbaum changed his policy; moving away from publicity, he established an inner circle of Committee members who would prospectively form a project team - just in case a project would come up. This happened, indeed, when a private party was interested in a short-range zeppelin-type airship to be operated around the Lake of Constance area. Then, a further disaster happened: the initiator was killed in a crash of a private airplane.-

In the Eighties, the activities of the Committee perpetuated on a low level. Klaus Decker, the deputy chairman, resigned and I became deputy to follow up any further activities in the LTA field. At that time, the Betriebsrat (Staff Representation Board) of the Vereinigte Flugtechnische Werke VFW, in Bremen (now DASA) had established a study team to investigate the potentials of airship manufacturing as a follow-on of the Tornado production, which was scheduled to taper off in the coming year. On the basis of the LTA Committee's data, a concept for the ecological surveillance of the North Sea was defined and proposed to the Management and the Bremen State authorities, where it was initially well received.

The Management, however, became very reluctant, especially since VFW had, in the meantime, merged with Messerschmitt-Bölkow-Blohm MBB. Therefore, the Betriebsrat pulled all strings to find a government-supported customer. This went on until 1987, when a new aspect arose, the initiation of the EUROMAR Project for the exploration and protection of the European Seas.

At this instance, a project engineer of Hapag-Lloyd, Klaus Henning, took the initiative with Walter Brockmann, now professor of material sciences in Kaiserslautern. A further questionnaire campaign was started with the help of the director of logistics of the Alfred-Wegener-Institute of Oceanography and Arctic Research in Bremerhaven, the late Dr. Heinz Kohnen. A first questionnaire evaluation revealed that five airships of that type could be operated in the West-European seas. The reaction was of several institutes was very positive, yet financing remained to be unresolved.

Therefore, a joint proposal for an encompassing airship development program involving major German industries and research institutes was prepared during the summer of 1989 to cover a wide scope of technologies, research applications and other potentials and was submitted to the Federal Ministry of Research and Technology.

Unfortunately, the proposal addressed - among many other applications - the potential of ecological surveillance of the German Sea. This particular item happened to be in conflict with the interest of certain parts of the German aviation industry. The proposal was declined on the grounds that airships are superfluous for surveillance purposes, since fixed-wing aircraft and helicopters in combination with patrol boats could well satisfy the current requirements of maritime surveillance.

An indirect effect of the perseverance of our activities in the political scenario, however, was the resumption of airship development at the Zeppelin Corporation in Friedrichshafen after nearly fifty years of dormancy. In 1991, a new concept was presented to the public by the demonstration of a radio-controlled operational model, and the starting point for the LZ NT07.-

3.5 Transition after 1989

The political events of November 1989 had changed the entire scenario, and the DGLR started to establish ties

the East German professional associations which were intensified after the reunification in 1990. Wolfgang von Kirschbaum, however, after about twenty years of arduous work in the field of airships on an honorary basis, felt that there are other fields of interest worth studying than the ungrateful world of airships. He collected the remaining scripts and edited his final report on Realistic Operations Potentials of Airships, dated 30 Sep 1992 [4].

On our last session in Cologne in September 1992, a completely new scenario came to being. There were two groups seriously interested in airship technology: a Dresden Group with Prof. Dr. Dr. Berthold Knauer, chairman of the Dresden Institute of Light Construction and Aviation Technology, and a Stuttgart Group headed by Prof. Dr. Bernd Kröplin, representing the faculty of Light Structures of the University of Stuttgart.

In the further course of the session, Bernd Kröplin stated his primary interest in the coordination of students teams interested in LTA within the scope the university. Von Kirschbaum transferred the chairmanship to me and, in the further course of reorganization, Berthold Knauer became elected Deputy Chairman.

4. The LTA Committee in the Nineties

4.1 A New Beginning

The situation now was entirely different from scenario in 1974, when the Committee was established. Instead of a heterogeneous group of individuals that needed organization and a strict work breakdown structure, there were in essence two academic blocs, Dresden and Stuttgart, with internal structures, concepts for new projects and their inherent dynamics. For the chairman, this constellation allowed a "laissez-faire"-style of guidance, as far the involvement in the individual professional activities was concerned, and it was immediately agreed to organize a two-days colloquium in May 1993, the first all-German LTA conference after the reunification.

The increased interest in LTA became evident, when other academic groups joined in the planning of the first colloquium, e.g. the Fachhochschule Aachen and the Technische Universität Berlin. In addition, industrial enterprises like Zeppelin, WDL-Wüllenkemper and GEFA-FLUG (hot-air airships) showed interest in participating in the colloquium.

The places chosen were Dresden and Lübbenau, where a new airship development site was planned in a former shoal coal territory. The first day of the colloquium, 14 May 1993, took place on the premises of the East German Engineers Association KDT, where everything was carefully arranged by Knauer and his associates. The number of attendants, however, was more than expected; so the auditorium became rather crowded and the agenda busted due to latecomers that had to be squeezed in.

Nevertheless, it turned to be a lively start, while in the following morning, everybody jumped into the cars and dashed 100 kilometers to Lübbenau, where the colloquium was continued in a deserted barrack on the shoal coal mining site. When the meeting was adjourned in the afternoon, it was decided to have another colloquium in 1994 in Lübbenau. The colloquium ended with a dinner party in the Chateau Lübbenau and show flights of two hot-air airships over the park of the chateau.-

From that time on, annual conventions have become a routine event, where a large variety of ongoing activities had a chance to present their results, where interdisciplinary research was encouraged and where a substantial exchange of ideas was made possible, almost like a social event.

As previously mentioned, the role of the Chair had changed insofar as the controlling function, aside of the logistics of convention management as well as the handling of political matters, were concentrated on three policy aspects:

- (1) Barring unprofessional presentations (which is not always possible for reasons of courtesy)
- (2) Producing own papers on subjects that seem to be missing in the overall trend, or to counteract potentially adverse developments
- (3) Promoting professional relationships between experts.

A particular rewarding aspect is the direct and indirect support of students in their thesis work and the given opportunity to report on their respective studies, - and it is hard to estimate, how many students have profited in the meantime from the increased interest in LTA ever since.

4.2 The Annual Conventions

Airship Colloquium II took place almost exactly one year later in 1994. The conference place chosen was the Chateau Lübbenau, a fine place after the renovation by the reinstated landlord, Graf zu Lynar. This event already had an international touch; CDR Charles A. Mills (US-Navy ret) prepared a paper which, in his absence, was recited by Hepburn Walker; and two Russian scientists and engineers, V. V. Asatyan and V. I. Utchvatov, had the opportunity to present their papers on new aspects of LTA technologies.

It became obvious that an annual cycle seemed to be just the appropriate period of time to collect new material and information for an efficient conference. Thus the following convention was planned in June 1995 in Cottbus on the premises of the Federal Horticulture Exhibition (Bundesgartenschau), the first one ever held in Eastern Germany. Needless to say that this choice was generally accepted as an attractive conference place.

In the following year 1996, the convention was planned to be imbedded in the major event of the Annual DGLR Convention in Dresden; a concept that eventually turned out to be a non-optimum solution, since the Committee's session had to be squeezed to a one-day's event. Nevertheless, the papers given still resulted in a remarkable volume of proceedings.

Courtesy of the industrial exhibition management allowed the 1997 convention, now called "Workshop", to be held during the bi-annual AERO International Aviation Fair in Friedrichshafen, where, among others, the new LZ NT07 was exhibited. A close-look inspection in combination with an informative tour was organized by the Zeppelin Luftschifftechnik GmbH for the attendants of the Workshop. From the international scene, the American Blimp Corporation provided a presentation on the recent development of the Lightship A-150.

In 1998, the subsequent "Workshop II" was arranged at another historic site, Zeppelinheim near Frankfurt-Main. Zeppelinheim was originally a housing development for the zeppelin crews and employees near the former airship terminal in Frankfurt-Main and has, in the past decades, built up a very fine zeppelin museum, now directed by Elisabeth Koetter. The presentations were accompanied by slides and videos showing test procedures and results of the LZ NT07 and A-150, respectively.

While this paper is written, "Workshop III" is in preparation to be held in May 1999 at the Institute of Technology in Bremen, as an initiative of Uwe Apel, professor of aerospace technology and Board member of the DGLR.-

5. Summary of Topics and Policies

This summary should give a concise survey on the different LTA-related papers and the policies of the LTA Committee. In retrospect, it may be stated that the percentage of inevitable lunatic presentations had been kept to an absolute tolerable minimum. A full listing of the papers so far presented is given in the Appendix.

Topics concerning the general analysis of LTA technology may be classified in four general categories:

- (1) Overall assessment of LTA systems in the present spectrum of transportation;
- (2) Methods of airship construction, ranging from non-rigid to rigid designs, including monocoque and metal-clad concepts and different configurations;
- (3) Propulsion options, including novel photovoltaic systems;
- (4) Historical reviews on personalities and earlier achievements in technology.

Item (1) in particular is based on various economic and operations analyses. Thus it became obvious that certain classical approaches are no longer applicable in the ever changing spectrum of transportation and more emphasis had to be placed on the prevailing economic and operational boundary conditions.

Item (2) is, in principle, dictated by the requirements that can be derived for the respective scenarios on the grounds of economy and operability. Hence, presentations of new concepts and projects, especially in the field of heavy lifters, have been scrutinized in view of their compatibility with existing constraints.

Item (3) offers new perspectives in the propulsion of LTA systems as the technology of photovoltaics is progressing. This development interlinks with the on-going endeavors concerning propulsion, guidance and control of unmanned LTA vehicles.

Item (4) has frequently been addressed, not only because of the interesting personalities involved, but also because of the fundus of "forgotten technologies" that quite often forces developers to re-invent the wheel.

Special attention was drawn on the subject of balloon technology, thermodynamic effects and the hot air balloon technology in particular. Considering the fact that larger airships are increasingly subject to aerostatic and thermodynamic effects, these experimental investigations are, indeed, of vital importance already in the conceptual design phases.-

The annual frequency of LTA conventions has encouraged several institutes to frequently present experimental data produced in connection with on-going LTA projects. Moreover, interdisciplinary research has been stimulated on account of the annual conventions, especially with reference to the results of bionics research (e.g. underwater drag of penguins).

In general, the prevailing aspects of interest are being investigated and their respective potentials are assessed in the context with surveillance and research platforms, advertising and tourism. In addition, the potentials of unmanned airships have attracted special attention in several fields of application.

Investigations concerning on-going problem areas are increasingly focussed on heavy cargo transportation in connection with the problems of positioning, maneuverability and ground handling. In view of these complex requirements, the concept of spherical airships has arisen increasing interest, since their practical application ranges from unmanned mini-airships to heavy cargo lifters with potentials far beyond the capabilities of transport helicopters.-

Appendix Presentations 1993 - 1998

1993 Colloquium, 14-15 May, Dresden/Lübbenau

B. Knauer (Inst. Luftfahrttechnik u. Leichtbau, Dresden) - *Polymer Composites as the Main Group of Selected Materials for Modern Airship Development*

W. Brockmann (University Kaiserslautern)
History of Airships

F. Möller (Inst. für Verbundwerkstoffe, Kaiserslautern) - *Design, Analysis, Construction of a Prototype and Flight Tests of a Novel Hang Glider Concept Using a Fiber-Reinforced Leading Edge*

Brockmann (University Kaiserslautern)
Possibilities of Weight Optimization on Airships

W. Hallmann (FH Aachen, Luft- und Raumfahrt) -
*Envelope Materials of Aerostats and the Influence on
the Flight Behavior due to Solar Irradiation*

R. Scharenberg, B. Knauer (ILL, Dresden) -
The Feasibility Equations of Airships

J.K. Bock (SLTA, Berne) - *A Parametric Analysis of the
Propulsion Efficiency of Known Airships*

C.A. Mills (CDR, SLTA, Beachwood, N.J.)
All-Weather Airship Operations of the US Navy

K. Hagenlocher (Luftschiffbau Zeppelin,
Friedrichshafen) - *Structural Concept of the New
Zeppelin Airship Technology*

B. Kröplin, M. Rehmet, I. Schäfer
(University Stuttgart) - *Project HELION*

D. Gottschling, B. Knauer (Dresden) - *Status and
Development Trends of the Dolphin Airship*

E. Gelhard (NovaTech GmbH, Cologne)
New Flight Systems Lighter-Than-Air

U. Scheibe, B. Knauer (Lübbenau) -
*Corporate Concept of the Demonstration and Test
Center Lübbenau/Groß-Beuchow*

H.W. Arnold, J.K. Bock (SLTA, Wittingen) -
Concept of a Large Multi-Purpose Hangar

G. Blum (Pro-Umwelt, Berlin) - *A Re-Assessment of
Transport System w.r.t. Environmental Compatibility*

1994 Colloquium II, 13-14 May, Lübbenau

B. Knauer, J.K. Bock - *Status of Development and
Application of LTA Systems in Germany*

R. Hochstetler (Washington, DC) - *The ARPA Naval
Airship Program and Other US Airship Activities*

V.I. Utchvatov, V.P. Utchvatova (Moscow) -
A Development Concept of Modern Airships

C.A. Mills (CDR, SLTA, Beachwood, N.J.) -
A Pilot's View of the US-Navy ZPG-2 Airships

W. Borchers (Oldenburg) - *Johann Schütte -
an Aeronautical Pioneer from Oldenburg*

W. Hallmann, S. Hallmann, U. Herrmann (Aachen) -
*Envelope Materials of Gas Balloons and Airships and
the Effects of Solar Irradiation*

B. Knauer, R. Scharenberg (Dresden) -
Sandwich Designs for Ultra-Light Construction

R. Küke, e.a. (Daimler-Benz Aerospace, Bremen) -
*TOPAZ - Low-Altitude Surveillance Using Mini-
Airships*

A.M. Hoff (Aerodata, Braunschweig) -
*The Airship as a Platform for Meteorological and
Geophysical Data Acquisition Technology*

Th. Lutz, E. Schmidt, S. Wagner (University Stuttgart)
Computation of the Air Flow about Airship Hulls

R. Bannasch (TU Berlin, Bionics) - *Mechanisms of
Biological Configurations - Recent Results of the
Bionic Research on Maritime Animals*

J.K. Bock (Berne) - *Geology of LTA Flight Systems
and their Spectra of Applications*

H.L. Baum, I. Fleiss (Cologne) - *Considerations w.r.t.
the Operational Potentials of a Universal Airship*

V.V. Asatyan (Moscow) - *Hazardless Utilization of
Hydrogen as a Lifting Gas and Control of Hydrogen
Combustion in Internal Combustion Engines and
Turbines Using Inhibitors*

H.W. Arnold, S. John (Wittingen) - *Problems
Regarding the Economical Operation of Airships*

M. Zoche (Munich) - *The Zoche Aero-Diesel -
a Propulsion System for Aviation*

1995 Committee Session, 16-17 June, Cottbus

B. Knauer (ILL, Dresden) - *Research and Technology
Needs for LTA Flight Systems*

M. Mandel (Zeppelin, Friedrichshafen) -
Development Status of the Zeppelin LZ N07

A.A.W. Khammas (Berlin) - *Utilization of Modern
Airships in Congested Areas*

B. Knauer, R. Scharenberg (Dresden) - *Airship Design and Construction as a Bilateral Challenge*

S. John, P. Kaukel (ILL, Dresden) - *Tentative Estimate of Operating Costs of LUTS-2 Airships for Environmental Monitoring*

Th. Lutz e.a. (University Stuttgart) - *Drag Computations on Bodies of Rotation w.r.t. Laminar/Turbulent Boundary Layer Transitions*

C. von Gablenz (Wiesbaden) - *The Global TransPark Network - A Concept for the 21st Century Economy*

H.H. Westerholt (Siemens, Offenbach) - *LTA CargoLifter 2000*

J.K. Bock (SLTA, Berne) - *LTA Heavy Cargo Carrier - Analysis of Technical Feasibility*

H.W. Arnold (SLTA, Wittingen) - *Tentative Cost Estimate of a Heavy Cargo Balloon*

V.I. Utchvatov (Moscow) - *Problems of Developing Control Systems for Aerodynamic Airships*

M. Prang (ILL, Dresden) - *Development of Structural Components*

J.K. Bock (Berne) - *Rigid Airship Baseline Configuration*

U. Scheibe, J. Weissbach (ILL, Lübbenau) - *LTA Infrastructure Project in Kittlitz/Lübbenau*

1996 Committee Session, 25 September, Dresden

M. Mandel (Zeppelin, Friedrichshafen) - *Present Status of Construction and Development of LZ N07*

C. Kühnel, S. John (ILL, Dresden) - *Economy of Airships - Analytical Comparison of Six Concepts*

B. Knauer, R. Scharenberg (Dresden) - *Feasibility Study on German/Russian Cooperation w.r.t LTA Development and Production*

W. Hallmann, E. Plescher (FH Aachen) - *Infrared Tests on Hot Air Balloon Envelopes - Results*

W. Hallmann, U. Herrmann, B. Justen, V. Schmidt - *Two Technical Notes on Hotair Airships*

Th. Lutz, U. Rüger, S. Wagner (Stuttgart) - *Theoretical Investigations w.r.t. Minimizing Aerodynamic Drag of Airship Hulls*

W. Hallmann, K.R. Schreitmüller (Aachen) - *Study Discussion w.r.t. a Power-Generating Stratospheric Balloon and a Cargo Carrier Balloon up to 600 Tons*

J.K. Bock (SLTA, Berne) - *The Spherical Airship as a Heavy Cargo Carrier - a Parametric Analysis*

F. Weiss (Ahrensburg) - *Selection Criteria for Airship Propulsion, Maneuvering and Hoisting Systems*

1997 LTA Workshop, 26-27 April, Friedrichshafen

J. Thiele (American Blimp Corp, Oregon) - *The A-100 / SpectorTM Airships*

I. Schäfer (Wetzlar) - *Progresses with Solar-Driven Airships*

Th. Lutz (University Stuttgart) - *Aerodynamic Peculiarities of the Airflow About Airships and Methods for Theoretical Prediction*

M. Mandel (Zeppelin, Friedrichshafen) - *Zeppelin NT - Construction Completed*

I. Schäfer (Wetzlar) - *CargoLifter Technical Data*

W. Brockmann (University Kaiserslautern) - *ZMC-2 - An Oddity of Technology or Future Concept*

A. Litz (Cologne) - *Iterative Development of the Zeppelins from 1900 thru 1938 w.r.t. the Overall Configuration*

J.K. Bock (SLTA, Berne) - *Considerations Concerning a Spherical Metalclad Airship*

F. Weiss (Ahrensburg) - *Propulsion, Maneuvering and Hoisting Systems for Airships*

K. Lange (HT Bremen) - *Systems-Engineering Concept of a Motorized Spherical Airship*

H. Jaeckel (HT Bremen) - *Design/Construction of an Intelligent Propulsion Module for Spherical Airships*

1998 Workshop II, 17-18 April, Zeppelinheim

- I. Alexander (Hilversum) -
The Re-Emergence of the Classical Rigid Airship
- A. Litz (Cologne) -
A Review on the Development of the Airship
- W. Hallmann, U. Herrmann (FH Aachen) -
Lift Augmentation by Increasing the Temperature of the Lifting Gas
- F. Weiss (Ahrensburg) -
Properties and Problems of Spherical Airships
- E.J. Brandreth (ABC, Severna Park, MD) -
FAA Certification of the Lightship A-150
- K. Hagenlocher (Zeppelin, Friedrichshafen) -
Experiences Gained During the Test Program of Zeppelin LZNT07
- K. Lange, N. Kern (FH Bremen) - *Control of a Spherical Mini-Airship Via Internet*
- A. Eenboom (Leer) - *The Successful Motorless Airship Concept of Dr. Solomon Andrews*
- J.K. Bock (SLTA, Berne) - *The Continued Development of the Aereon Airship 1963 - 1971*
- E.H. Geyer (Brockscheid) - *Utilization of Airships as an Astronomy Observatory Platform*
- Mei Lu (DLR Göttingen) - *Drag Reduction of Blunt Bodies by Passive Ventilation*
- J.K. Bock (SLTA, Berne) -
Structure of a Large Spherical Airship
- C. Haubrock, S. Tirre (FH Detmold) - *Interior Architecture of a Spherical Cruise Airship*
- F.P. Schäfer (Göttingen) -
Proposal of a Cruise Airship
- B. Knauer, R. Scharenberg (ILL Dresden) -
Aerodynamic Measurements on an Airship Hull having a Low Slenderness Ratio
- A. Jakobi, P. Funk, Th. Lutz, S. Wagner (Stuttgart) -
Aerodynamic Investigations on Inclined Airship Hulls

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Annex

1999 Workshop III, 28-29 May, Bremen

- I. Alexander (Lelystad) -
Realities of Large Airship Design
- A. Litz (Köln) -
What Effect do Inertial Forces have on Airships?
- B. Wiedemann (Braunschweig) -
Investigations of the Load Carrying Properties of Semi-Rigid Airships
- R. Bannasch (Berlin) - *Bionic Mechanisms and Structures in Airship Design*
- F. Böhm (Berlin) - *Experiences with a Thrust Vector Controlled Airship*
- B. Hoffmann (Berlin), B. Knauer (Schönbrunn), R. Scharenberg - *HeliKran: a Short-Range Transport Airship*
- Siebert (Leipzig), A. Hoff (Braunschweig) -
Measurements of the Physics of Turbulences in Clouds Using Airship-Suspended Sounding Systems
- P. Funk, Th.Lutz, S. Wagner (Stuttgart) -
Experimental Investigations of the Velocity Vector Field Following an Inclined Airship Hull
- A. Jakobi, Th. Lutz, S. Wagner (Stuttgart) - *Influence of the Pressure Distribution on the Hull for the Computation of the Three-Dimensional, Frictional Airship Flow Pattern*
- Ph. Stabenau (Braunschweig) -
Transport Airship Requirements - History and Present Status of the Requirements
- K. Lange, R. Küke, U. Apel (Bremen)
Concept and Design of Spherical Mini-Airships and First Results of Flight Tests
- J.K. Bock (Berne) - *Igloo: an Amphibious Stationary and Airborne Research Platform*
- H. Yusan, St. Rudolph (Stuttgart) - *Knowledge Integration in Conceptual Airship Design*
- W. Knaupp (Stuttgart) -
Solar Electrical Energy Supply for Airships
- A. Eenboom (Leer) -
Experimental Jet Propulsion Without Moving Parts
- R. Bartel (Hillsboro) -
Status of the ABC Airships
- I. Schäfer (Lahnau) -
Aerostatics - a Peculiarity of LTA Systems
- U.Scheibe (Lübbenau), B.R. Ahlbrecht (Berlin)
Airship Operations in Berlin-Brandenburg - Yesterday, Today and Tomorrow
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Aeronav: Integrated Navigation and Mission Management System
- F. Weiss (Ahrensburg) -
Maneuvering Systems for Aerostats