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BUREAU OF AIR COMMERCE

SAFETY AND PLANNING DIVISION

NOTE NO. 1

SUPPLEMENTAL JUSTIFICATION FOR 1938-39 BUDGET ESTIMATE

Sept. 28, 1937

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I N D E X

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INTRODUCTORY STATEMENT

A statement of the aims and purposes of the Safety and Planning Division of the Bureau of Air Commerce, together with a description of some of the work now going forward in that Division were delivered to the Bureau of the Budget in conjunction with the Air Commerce Budget Estimate for 1938-39.

That general description also contained the statement, which we now reaffirm, that it would be most unwise to definitely decide at this time in full detail the specific projects which should be undertaken during the period covered by the Budget estimate. Many of those details cannot be intelligently determined until results are available from the projects now being worked on. We realize, however, that the Bureau of the Budget and the Congress desire definite assurance that money appropriated will be expended wisely and to the advantage of the Government. It is to provide that assurance that this detailed material has been prepared.

DETAILS OF PRESENT WORK

At the time of writing, the Safety and Planning Division is not yet functioning in a normal manner by reason of the apparently unavoidable delays attending the establishment in the Government of new positions and our consequent inability to appoint contemplated and badly needed personnel. In spite of these circumstances, however, a comprehensive program for the Current fiscal year has been drafted. Details of this program, together with its aims and purposes, are to be found on the following pages. It is felt that such details are of interest because they indicate the type and scope of the activities which will be continued in the fiscal year 1938-39.

COPY OF LETTER SENT TO ALL
AVIATION AGENCIES

There are forwarded herewith, for your information, two copies of a brief article which explains in a general way the plans of this new Division of the Bureau of Air Commerce. We would like to keep you well-informed in this respect so that there may be a maximum of the mutual understanding which we feel is essential to the best interests of everyone concerned.

The most important project which we propose to initiate at this time is the establishment of a thorough understanding on our part of all of the problems which face the aviation industry, particularly those relating to safety. Those for which there seems some hope of solution by Bureau action should, we believe, be tabulated or charted and classified as to apparent relative importance. This will permit us to use our limited funds to best advantage by undertaking the most important work first.

With this end in mind we should appreciate receiving any suggestions which you may have as to projects that should be undertaken or sponsored by us. We are most anxious that you appreciate the sincerity of this request and the importance which we will attach to suggestions from well-informed sources in the industry.

DEPARTMENT OF COMMERCE
BUREAU OF AIR COMMERCE
Washington

RESEARCH AND DEVELOPMENT PROJECTS COORDINATED UNDER SAFETY AND PLANNING DIVISION

(Reprint from Air Commerce Bulletin of Sept. 15, 1937)

All research projects and special studies bearing on the development and safety of aeronautics and conducted or supervised by the Bureau of Air Commerce are now coordinated under the Safety and Planning Division recently created under the reorganization plan for the Bureau. Richard C. Gazley, formerly Chief Aeronautical Engineer, who has been appointed Chief of the new division has supervision over seven sections concerned with problems relating to aircraft, airports, air transport, education, international relations, power plants, and radio development.

The Safety and Planning Division will, in general, study trends in the industry, sponsor certain types of research and investigation, and on the basis of these studies guide the Bureau in a long range planning program.

Projects previously in progress have been assigned to the new division and a number of new ones needing special study will be undertaken. By closely following all problems affecting civil aeronautics, and those bearing upon the relationship of the Bureau of Air Commerce to the industry, the Division will be in a position to guide the Bureau of Air Commerce in formulating policies on current problems in aeronautics, such as those affecting regulations and air navigational aids, and

will enable it to anticipate and make preparations for coming developments.

The scope of the Division is large, covering as it does practically the entire field of aeronautical research. Since the work of the Division will be largely of a coordinating nature, it will not in any way conflict with projects now carried out by other Governmental agencies. For example, the Bureau will undertake no study which is already under consideration by the National Advisory Committee for Aeronautics, or which appropriately should be referred to the N.A.C.A. instead of being attacked by the Bureau. However, the Division will cooperate closely with such agencies and will exchange data where beneficial. Likewise, it is planned to take full advantage of the facilities of interested industrial laboratories and organizations wherever possible.

The Division will obtain, from every possible source including the observations of its own personnel, suggestions as to research development projects, and will, upon study of these suggestions, attempt to allocate to each its proper place in a long range planning schedule. As many as possible of the most urgent of these projects will be allotted on this year's schedule, the method of handling each case being dependent upon its nature and the facilities which are available in the Government and in the industry.

All projects previously started will be carried out unless study indicates the advisability of discontinuance in specific cases.

Projects adopted by the Division will be allocated among its seven sections according to the nature of the subjects. These sections are as

follows: Aircraft, Airport, Air Transport, Educational, International, Power Plant, and Radio Development, all of which are now functioning with the exception of the Educational and International Sections. These will be organized later.

Projects assigned to the various sections are as follows:

Aircraft Section

The Aircraft Section will carry out all aircraft, aircraft instrument equipment projects previously instituted and will seek, in addition, to determine the needs of the aircraft manufacturer and operator with respect to aircraft, instrument and equipment. It will also study all ideas and inventions submitted to the Bureau.

Specific projects include:

1. Supervision over existing aircraft contracts.
2. Survey of patent laws and regulations as affecting Bureau development contracts and the formulation of appropriate Bureau policies.
3. Determination of status of existing devices for the prevention of ice formation on aircraft ailerons, windshields, and instrument pitot heads, and the development of suitable means if none exist.
4. Development and test of a means for visually reproducing in the aircraft cockpit a properly orientated chart of an airport.
5. Study of proposals for assistance to glider constructors and pilots.
6. Development and test of a means for recording instrument readings in an airplane cockpit continuously and automatically.
7. Representing the Government's interests with respect to an existing contract with Massachusetts Institute of Technology for a blind landing instrument and system.

Airport Section

The Airport Section will consult with states, municipalities, aircraft manufacturers, and others in the interest of greater safety and convenience in aeronautical operations at airports of the United States and to the end that development of a coordinated civil airways system and the improvement of airports may keep pace with other aeronautical

developments. Specific projects are as follows:

1. Determination of requisites for a transoceanic seaplane terminal.
2. Development and test of a camera and means for its use to measure airplane performance near the ground.
3. Compilation of a photographic record of all United States airports.
4. A national survey of airport facilities and tabulation and chart of results.

Air Transport Section

In general, the Air Transport Section will maintain close contact with air lines and other operators with a view to finding answers to problems connected with the movement of aircraft in commerce. Individual projects are:

1. Preparation of a chart showing the elements involved in the safety and planning work of the Air Transport Section and the inter-relating of such elements.
2. Analysis of the pilot fatigue problem.
3. Representing the Government's interests in connection with an existing contract with Columbia University for research work dealing with the effect of altitude on pilots.
4. Study of published airline accident reports, particularly those resulting in a finding of pilot error and determination of contributory causes.

Power Plant Section

This section will seek to determine the hazardous factors in power plants and will attempt to find means of reducing those hazards. It will also keep in close touch with new power plant developments and foster them whenever advisable and possible. The following are specific projects:

1. Supervision of an existing contract for a barrel type engine.
2. Endurance test of Funk engine.
3. Study of power plant vibration and development of means and recommendations as to the application of such means for the prevention of propeller failures resulting from vibration.

Radio Development Section

Studies looking to the practical development of radio air navigational facilities will be the chief concern of the Radio Development Section. Specific projects include:

1. Testing of Knoxville and Roanoke radio ranges to determine effects of counterpoise and silultaneous operation.
2. Development and test of radio teletype communication means.
3. Testing a 125 Mc. transmitter to determine its suitability for use in air traffic control.

4. Development and test of fan type radio marker.
5. Development and test of Z type and fan type radio marker receivers.
6. Development and test of Z type radio marker.
7. Development and test of receiver for ultra-high frequency radio range.
8. Development and test of ultra-high frequency radio range.
9. Development and coordination of installation of radio instrument approach system.

In addition to these projects, special problems in lighting research are being carried out at the U. S. Bureau of Standards for the Safety and Planning Division. These are:

1. Development and test of a flush type aircraft position light.
2. Study of available aircraft landing lights and formulation of recommendations as to regulations pertaining thereto.
3. Development and test of suitable airport runway illuminators.
4. Study of the optical qualities of rotating airways beacons with reference to the speed of rotation and the light intensity.
5. Determination of the optimum specifications for aviation colors.

The projects outlined in the foregoing constitute the preliminary program for the Safety and Planning Division. As the work progresses, the necessity for research and development work on various other projects will undoubtedly come to light and these will be included when possible.

PLANNING FOR SAFETY

By
Richard C. Gazley, Chief
Safety and Planning Division
Bureau of Air Commerce

All of you, I am sure, are familiar with the remarkable progress that has taken place in aviation within the past few years. It has been a development that has touched the daily lives of all of you in one way or another. It has made possible the speedy delivery of mail and express and has enabled us to travel distances in a matter of hours that only recently required days. In addition, many of you probably use your own aircraft in daily business for the transportation of materials and personnel, or in your recreation hours for pleasure and relaxation. Or, if you do not, you more than likely have friends or know of some one who does make use of the airplane in this manner.

Naturally the question of safety is of paramount importance. If an aircraft were not reasonably safe, then it would be of little use. For, despite its unquestioned advantages in the matter of speed and comfort, no one would care to gain these advantages at the risk of his life.

Fortunately, however, safety has kept pace with the growth of aviation, and there are relatively few accidents, considering the volume of travel. Of the accidents which do occur, only a small percentage can be attributed to structural or mechanical failure. The use of better materials, increased skill in the fabrication of aircraft, and improved engineering technique have seen to that. Fortunately also that fine group of individuals which comprises our pilots has been able generally to keep in step with the increasing complexity of the machines by displaying a high degree of skill and competency.

Despite the fact that we have attained a large degree of safety in present day aviation, our job is not done -- as a matter of fact there is yet a huge unexplored field before us. We must not only prepare the way for further improvements in mechanical safety, but we must learn more about the human factor, and find out what can be done to decrease its importance, and extend our field of inquiry into realms about which we now know little.

Even if all aircraft development were to stop now our job would not be finished because we are a long way from understanding all of the problems of present-day aviation. But progress will not stop. Next year's land transport will be larger, and probably faster, than any now built. Next year's ocean transport will be almost twice as large in carrying capacity, as the largest flying boat now operating. The rapidity of these developments is breath-taking in itself and is amazing when you consider that each step forward must be preceded by exhaustive research and study to insure both safety and efficiency in a totally unexplored field. It is like a man running in the dark over rough ground, which would be utterly impossible without a torch to light the way.

The Bureau of Air Commerce is concerned primarily with safety in all its phases. It imposes regulations and restrictions upon all types of civil flying for the purpose of making certain that aircraft are airworthy and airmen are competent. But, in addition to this, the Bureau has long realized the necessity for study, planning and experimentation, and has engaged in a certain amount of this type of work toward the end that its regulations and policies should be helpful rather than entirely restrictive. The industry has, of course, conducted extensive experimentation in order to perfect equipment and improve its services.

The Bureau of Air Commerce has been, in the past, particularly concerned with the improvement of aids to air navigation on the Federal Airways System, although also engaging in other experimentation. As there have been few precedents by which manufacturers of this type of equipment could be guided, the Bureau, as practically the sole customer for airways aids, has found it necessary to design a large share of the material needed for installation on the airways.

In its planning work, each regulatory official of the Bureau and each executive concerned with installation of airways aids, has tried to carry on his work with one eye on today and the other on tomorrow, to the end that regulations placed in force today, and airways installed today, should not be antiquated two or three years from now.

That policy worked very well when the industry was small and development proceeded slowly. We could foretell with some degree of accuracy, what changes could be expected, and as our regulations were made flexible from the start, it was comparatively easy to make the changes required to take care of advances as they came. When the airway installation program was formulated, it was so planned that the airways would not reach their full capacity within any one period, and plans were made for an increase in the number of aids and the total mileage of the airways from year to year to accommodate additional flying.

In other words, it was possible to take care of problems as they arose and make adequate provision for them without any compromise with safety. However, in the last year or so, aviation has swiftly become a highly complex and highly technical factor in the transportation world. This growth has come so rapidly that we have had just about all that we could do to take care of problems as they arose, without an opportunity for thoughtful planning for the future.

Due to the necessity for full attention and full time to the needs of air transportation for the present, there has been little opportunity for the consideration of much needed safety work, revision in technique, or changes in general policies of the Bureau.

In taking stock of the situation, the Bureau concluded that the obvious remedy was the creation of a division for the sole purpose of taking charge of, and being responsible for, all work concerned with planning for the future of aviation. In this way, other divisions would be free to carry out their existing duties in connection with enforcement of regulations, and construction, maintenance and operation of airways facilities. In this manner was born the Safety and Planning Division.

Before I go into details as to the progress of this division, I should like to present for your inspection the word "Safety." As you know, that word is one of the most vital and yet one of the most poorly defined in our entire lexicon. The same is true of its antonym "Dangerous." In driving your automobile, for example, you have often seen warning signs reading "Dangerous Curve" or "Dangerous Intersection." As a matter of fact that curve or intersection probably is not in the least dangerous if your driving is governed to accommodate the particular situation encountered. A safe curve or intersection would seem to be one which could be negotiated with a minimum of care and attention. Similarly, in aviation, when we speak of work looking toward greater safety, we really mean the process of making aircraft easier to fly, capable of going through severe weather without danger, and capable of being handled with a minimum of care and attention.

Planning and development work in the Bureau for the purpose of bringing about greater safety has not been entirely neglected because it has been difficult. As a matter of fact, a surprising amount of work has been undertaken in many fields. For instance, development work on a practical instrument landing system has been going on for a number of years, many improvements have been made in the field of radio, a large number of devices have been perfected to assist in the navigation and safer operation of aircraft, and work has been going on in other avenues, such as lighting research and aircraft development. However, in the past, this work has been carried on more or less independently and without systematic coordination.

The formation of the Safety and Planning Division brought into being an agency which would bind all of this development and research work into a single unit with clearly defined objectives, the advantages being obvious. All sections heretofore engaged in safety and planning work have been brought into the new division and several other sectionshave been added to extend needed research into other fields.

As its name indicates, the Safety and Planning Division is the planning agency for the Bureau of Air Commerce, with safety as a central theme. The scope of this division is large, requiring as it does a knowledge of the entire field of aeronautical research. In general, the Safety and Planning Division will study trends in the industry and sponsor and coordinate, or initiate, certain types of research and investigation, and on the basis of these studies guide the industry and the Bureau in a long range program. This division will therefore serve as a clearing house and coordinating agency with respect to the research needs of the industry and the Bureau.

The specific nature of the work of the Safety and Planning Division can best be presented by illustrations of projects which are being undertaken.

One section of the Division is devoted to aircraft problems. As you will agree, the field is large, in spite of the fact that great progress has been made in aircraft design and construction.

The handling qualities of aircraft present one problem, especially in the smaller types which have been criticized from time to time as being too difficult to learn to fly. Several contracts, looking toward improvements in this direction, were let prior to the formation of this Division. Whether or not these will provide a clue to the course of further research cannot be determined at so early a date. Much has been done in the way of inventions and development along this line for years, of course, but as yet there does not seem to be any formidable rival to the conventional airplane as a practical vehicle. Perhaps the answer lies in the further improvement of conventional types, I could find you well-informed persons to argue either side of the question. As for myself, I do not know the answer.

In any event, the question has certainly not been finally settled for once and for all, and if it is possible to construct a plane that can be operated safely with a minimum of piloting skill, it is without a doubt a subject worth further research.

In addition to problems connected solely with the mechanics of aircraft construction and operation, there is the problem of weather which has always been with us. A formidable foe of all forms of transportation, weather assumes even more importance in aviation, for in the air a pilot is almost entirely at the mercy of the elements, unless he is armed with efficient and proved safeguards to offset each danger as it is presented.

Ice has been one of the most stubborn and persistent trouble makers, but a great deal has been accomplished in the fight against it. Ingenious de-icing devices, which by a pulsating movement crack ice forming on the leading edges of wings and tail surfaces, have been developed and are in service use. The formation of ice on propellers has long been one of the outstanding hazards of aircraft operation. A major advance in the solution of this problem has been brought about by the Bureau of Air Commerce in cooperation with the aeronautics industry, with the development of a simple device known as a "slinger ring" which provides for the continuous feeding of an anti-ice solution to the propeller blades while the aircraft is in flight.

Ice formation in carburetors, equally as hazardous to safe flight as that on propellers, has been the subject of extensive research by Bureau engineers. Ice in the carburetor checks the flow of fuel mixture, and this may occur even when the outside temperature is as high as 50 or 60 degrees Fahrenheit, due to the fact that the vaporizing fuel causes a temperature drop. The development of a type of carburetor that would be inherently ice free was sponsored by the Bureau, and was completed.

There remain, however, some very important problems in connection with ice formation. Ice still has the annoying and dangerous habit of freezing on windshields, thereby obstructing the pilot's vision, and on pitot heads, causing inaccurate instrument readings. Ice formation on certain types of ailerons can also present a hazard. A number of organizations, working independently, have been busily engaged on these problems and it is obvious that the Bureau should give whatever impetus and help is needed to the end that everyone interested may have the results available at the earliest possible moment. We are preparing to act accordingly.

Present types of position lights, which protrude from the surface of the airplane, provide a start for the formation of ice on wing tips and present another problem. We believe that a satisfactory flush-type light would provide added safety and work is now being undertaken toward that end. An added advantage of such a light would be its contribution to increased aerodynamic efficiency.

Sometime ago an airline pilot brought to the Bureau an idea that was thought of so highly that we are sponsoring its development. Not yet complete, the plan is to provide in the airplane cockpit a properly orientated chart of an airport. When descending through thick weather, the pilot would see by this means an accurate reproduction of the airport below him just as he would see the airport itself in clear weather. He is then in a much better position to aline his plane with the proper runway and avoid obstructions. Such an idea, if seriously advanced years ago, probably would have been considered somewhat visionary, but it very definitely has practical possibilities today.

Airports, it goes without saying, are an essential part of aviation, and we would be helpless without proper and sufficient airport facilities. For a number of years the Bureau has maintained a section devoted entirely to airport work. The engineers of this section have been available for consultation with city, town, and community officials interested in constructing or improving their airports. Under the emergency works program, the Airport Section has worked closely with the Works Progress Administration and its predecessors in a nationwide airport construction and improvement program.

The Airport Section, which is now a part of the Safety and Planning Division, will continue this work, and it has been assigned additional duties in connection with future planning.

One of these projects is closely concerned with a problem which we have with us today and which will be even more pronounced in the future -- the relation of the size and location of airports to the types of operations conducted from them. In an effort to obtain exact information as to take-off and landing distances required by different types of airplanes in varying atmospheric conditions and at different altitudes, motion picture cameras are being used to photograph various aircraft as they land and take off. The pictures are then placed in a specially designed and calibrated projector which throws the images on a ground glass screen. In front of the screen and directly against it is a glass grid which enables the observer to read directly the rate of climb and angle from the take-off point. This information, together with the recommendations and advice of the Post Office Department, Navy Bureau of Aeronautics, Army Air Corps, private flyers, scheduled air lines and commercial operators, and data from other sources will be the basis for future airport planning.

Another project assigned to the Airport Section calls for the compilation of a photographic record of all airports in the United States. These will be assembled from the Army, National Guard and other agencies, and will be brought up to date by field personnel of the Bureau of Air Commerce and scaled. The photographs will show facilities of all kinds, whether zoned or not, area available for expansion, drainage system, length and direction of runways, types of hangars and other buildings, lighting system, communication system, type of field, and storage transportation

facilities. Much of this information will be collected from a nationwide survey and sketched on the photographs. The complete data will be used to determine the classification of various airports in the formulation of plans for development over a long period. By comparison of facilities shown on the photographs and information collected by the survey with the opinions of airport officials, the types of aircraft that can be ultimately handled by each airport can be determined. A financial survey will also be conducted, and this in conjunction with the survey and photographic project will enable the Bureau to determine the estimated cost of the development of a field and facilities to its ultimate capacity.

Somewhat related to airport problems and also of major importance in air transportation are the long range planning aspects of so controlling airway traffic as to prevent collisions and at the same time to keep airports and airways available as public facilities.

About a year ago the Bureau inaugurated an airway traffic control system to relieve congestion along the airways and at major airports. This system is under the jurisdiction of the Airways Operation Division, which must necessarily concern itself with problems of the present and immediate future. The Safety and Planning Division, through its Air Transport Section, will be concerned with the future aspects of this problem, for just as it has become of importance today it will certainly assume a far greater importance year after year as the amount of traffic increases. Therefore, in our planning program we must attempt to ascertain just what proportions this increase will assume, in which direction it will be, and shape our plans accordingly so that we will not be caught off guard with an outmoded system five or six years from now.

Another major field of inquiry concerns the human element. This is a problem to which no existing rules can be applied. We can set up exacting limitations and requirements as to physical fitness and piloting skill, but there we must stop. From then on we are confronted with questions about which little is known. We have designated this problem as "pilot fatigue".

The project which is set up under this somewhat vague heading seeks to determine in specific terms those factors which impair the efficiency of a pilot to the end that such factors may be eliminated, minimized or controlled. This is a vital problem, magnified as it is by the increasing size, speed and complexity of modern and projected airplanes. It is obvious that the amazing adaptive qualities heretofore displayed by American pilots cannot be stretched to a mastery of unlimited complexity and it may be true that, even under present conditions, the strain of competently handling their jobs is shortening the useful life of the pilots.

A considerable amount of research has been conducted on the problem, but there is still an untold amount of work to be done in order to reach satisfactory answers and the Bureau has accorded this project a prominent place in its program.

Returning to mechanical problems, we encounter the subject of power plant vibration and its relation to propeller failures. Under some conditions a combination of vibration in the power plant and engine mount is set up which if allowed to continue may produce a dangerous amount of fatigue in the propeller.

In present types of aircraft we know the points at which the vibration will become dangerous, and the necessary precautions are taken to avoid the danger zone. Our problem then is not concerned so much with the elimination of vibration in present types, but with finding means to predict and avoid dangerous combinations in new designs now in the jig and on the drawing board. The Bureau has given full recognition to this problem and is now conducting studies in cooperation with the industry to develop means for the prevention of propeller failures due to this cause.

The projects assigned to the Power Plant Section relate to its general responsibility of determining the hazardous factors in power plant operation with respect to both forced landings and fire, and finding means to eliminate those hazards.

The Bureau has maintained a radio development section for a number of years which has been concerned chiefly with the development and perfection of radio aids to air navigation and this is now a part of the Safety and Planning Division.

You all are familiar with the role played by radio in the navigation of aircraft. As aircraft operations have been extended, radio has become increasingly important. On the Federal Airways System more and more emphasis is being placed upon radio. In former years, contact flying was more or less the rule in aircraft operation, as the aids necessary for flying for long periods out of sight of the ground had not been perfected for extensive use.

However, the use of radio has diminished the weather hazard from year to year as new devices and new means of replacing visual contact with radio information have been perfected. Now aircraft fly more or less as a matter of course above the clouds and away from sight of the ground, but still receive all the information needed to conduct the flight safely and without dependence upon ground landmarks. However, it must be pointed out that certain restrictions still limit this type of flying. Regulations forbid the starting of any flight in the face of known dangerous weather conditions, but if a pilot should encounter such conditions unexpectedly while in flight, it is possible for him to complete the flight although his vision may be shut off for protracted periods.

Most of you are probably familiar with the Federal System, but to refresh your knowledge I shall outline briefly the manner in which it functions:

Beacon lights and intermediate landing fields are spaced at regular intervals from airport to airport. The beacon lights outline the course by dots of flashing lights, and the landing fields are available if the pilot should need to land before reaching his destination.

Then there are the radio stations of two general types, those which furnish voice information to the aircraft pilot and those which furnish radio directional guidance by means of aural signals. These in turn are divided as to broadcast strength.

Also there are the teletypewriter circuits which form a huge communications network, the principal function of which is to collect weather information from points along the airway. This information is placed on the machines at various points in sequence and is carried directly to the weather broadcast stations. There it is coordinated and broadcast to pilots.

As the type of aircraft operations on the airways has changed from year to year it has been necessary for the Bureau not only to keep abreast of these changes so that the aids to air navigation could be revised to accommodate the new developments, but it has been necessary that plans be made for future needs.

The bulk of the airways system is so huge that revisions cannot be made over-night, and in the past, improvements have been made more or less gradually as equipment required replacement, or as new routes were constructed. This has served to keep the airways abreast of developments to a great extent, but changes have come so rapidly within the past few years that it has been necessary for the Bureau to plan for complete revision and modernization of the system. The Bureau is now starting on a large scale improvement project which will bring its facilities up to date in every respect.

Many of these improvements have been made possible by research and development work on the part of the Radio Development Section. It has been concerned largely with the indexing of future requirements and the carrying out of experimental work necessary to perfect new ideas. Because it has been concerned with requirements of the future, it is now possible for the Bureau to go ahead with its modernization program which will place in service use equipment which was in the laboratory several years ago.

Further improvements are still in the laboratory or just emerging from it. For instance, a large amount of work has been devoted to the perfection of a means by which teletypewriter machines could be operated by radio and reliability equal to land line operation has been obtained. The Bureau's radio development engineers are now seeking means by which teletypewriters may be placed in aircraft and the information transmitted directly to the pilot. The pilot will receive written messages in flight, thereby preventing misunderstandings, and also leaving the crew free to examine the messages later.

With the growth of radio, the question of frequency allocations in the bands now assigned for aviation purposes has become a pressing one. In order to get around this problem, and also in an effort to obtain certain distinct advantages, the utilization of ultra-high frequencies is now under serious investigation. Two new types of radio marker stations developed for airway traffic control purposes operate on ultra-high frequencies and consideration is now being given to the utilization of these frequencies for radio range use.

The radio range stations, upon which a pilot is dependent for directional guidance along the airways have a tendency in some localities to present bent and multiple courses which give the pilot false indications of his position with respect to the airway. Static, which sometimes blankets out the signals, is also a disadvantage.

It is now felt that the use of frequencies in the ultra-high zone would eliminate many of these disadvantages or at least minimize them to the point where a greatly increased efficiency and reliability would be obtained. Projects concerned with the development and test of ultra-high frequency radio range transmitters and receivers have been assigned to the Radio Development Section for immediate consideration.

Also in the field of radio is the problem of landing aircraft when low visibility makes it impossible for the pilot to make a normal landing by visual contact with the ground. While in the air, the pilot can navigate by means of his instruments and radio if visibility is lowered by fog or other conditions. It is possible for him to locate the airport by instrument and radio, but he must be able to see in order to land his airplane.

We are confronted, then, with the problem of finding some means to replace the necessity for visual contact with other means of furnishing the information necessary to complete the landing.

At present, if a pilot learns by radio that the airport at which he is to land is closed in, he must land at another airport, and on all airline flights certain airports are designated in advance as alternates so that he can complete his flight safely even though it does not end at the scheduled stop.

This, of course, seriously interferes with schedules, although it is imperative that safety be considered first of all. But, it causes inconvenience to passengers who must wait until the weather clears at the terminal airport or proceed by some other means of transportation.

The Bureau of Air Commerce and the aviation industry have been concerned with this problem for a number of years, and active work has been under way in an effort to perfect a practical instrument landing system. During the past ten years several types of landing systems have undergone development and tests and a considerable fund of information concerning the advantages and disadvantages of each has been obtained. A survey of all types has been made and it is now possible to fulfill the requirements of a satisfactory system by combining the best features of those proposed in the past. The major airlines, the Federal Communications Commission and the Bureau of Air Commerce are now in agreement as to the features necessary in a practical instrument landing system.

While radio is becoming more and more important to air navigation, effective airway and airport lighting is still of prime concern and the Bureau is conducting research looking toward the improvement of facilities of this type. It has assigned to the National Bureau of Standards, research projects looking toward improved airway beacons, aircraft landing lights, runway illuminators and other problems in lighting.

All of the subjects discussed in the foregoing inaddition to others of a similar nature are on the immediate program of the Safety and Planning Division. We know that these are not by any means all of the questions that must be answered, but they are all important and of immediate concern.

Laboratory work in connection with carrying out projects adopted by the Division will be performed by agencies outside of the Bureau of Air Commerce, preferably commercial laboratories, under the general supervision of the Bureau and supported in part or wholly by our funds. Where it is necessary to determine specifications to guide outside agencies, the Bureau will do some development work, but it seeks to avoid even such activities if the result can be satisfactorily obtained otherwise.

The most important project of all has not yet been touched upon. It consists of a determination, study and classification of the present and future needs of the industry, the results of which should form the basis for our future program. In other words, it is largely futile for us to attempt long range planning for the industry or the Bureau until we have first conducted some intelligent planning for ourselves. This work is now under way and should provide intensely interesting results. It will never end, of course, but perhaps that is the secret of the fascination of this profession.

These problems are not the Bureau's concern alone. They are of importance to the entire aviation industry and to every one who makes use of aviation in any form. The Bureau is acting chiefly in a coordinating capacity and is furnishing facilities for the prosecution of this work so that it will be carried out along definite lines. It cannot carry the entire burden alone, and, therefore, we are extremely anxious to have suggestions and information from any informed source so that we may truly be in a position to aid the related causes of aviation and safety.

We should like to have your individual cooperation. If you have any definite ideas as to projects which should be undertaken, the Bureau is anxious to have them and you may be sure they will be given the fullest consideration.

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DEPARTMENT OF COMMERCE
BUREAU OF AIR COMMERCE

August 12, 1937

SAFETY AND PLANNING DIVISION

STATEMENT OF PROJECTS

IN PROCESS

17981

EXECUTIVE PROJECTS

Project No.	Description	To whom assigned	Report Due
6-1	Circularize industry to obtain suggestions as to safety research needed, analyze and chart results	F. Brinkley J. Easton R. Humphreys W. E. Jackson	Nov. 1, 1937

AIRCRAFT SECTION PROJECTS

Project No.	Description	To whom assigned	Report Due
61-1	Study Army, Navy and Commerce agreement with reference to the development of fog dispelling device at Massachusetts Institute of Technology and report as to further Commerce participation	I. R. Metcalf	Aug. 20, 1937
61-2	Study existing contract with Arrow Aircraft & Motors Corp. for an experimental airplane and recommend appropriate action	J. Easton	Sept. 1, 1937
61-3	Study existing contract with Stearman-Hammond Aircraft Corp. for an experimental airplane and recommend appropriate action	J. Easton	Sept. 1, 1937
61-4	Survey patent laws and regulations as affecting Bureau development contracts and formulate appropriate Bureau action	J. Easton I. R. Metcalf	Nov. 1, 1937

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AIRCRAFT SECTION PROJECTS - 2

Project No.	Description	To whom assigned	Report Due
61-5	Determine status of existing devices for the prevention of ice formation on aircraft ailerons, windshields, and instrument pitot heads, and develop suitable means if none exist	J. Easton I. R. Metcalf	Prelim. Aug. 20, 1937 Final Dec. 1, 1937
61-6	Study existing contract with Funk Aircraft Co. for an experimental airplane and recommend appropriate action	J. Easton	Prelim. Sept. 1, 1937 Final Dec. 15, 1937
61-7	Develop and test a means for visually reproducing in the aircraft cockpit a properly orientated chart of an airport	I. R. Metcalf	Dec. 15, 1937
67-8	Study the proposal of the Soaring Society of America as to a glider handbook and take appropriate action	J. Easton	Prelim. Sept. 15, 1937 Final Dec. 15, 1937
67-9	Represent the Government's interests with reference to an existing contract with Management & Research, Inc. for a tailless airplane	J. Easton	Feb. 1, 1938

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AIRCRAFT SECTION PROJECTS - 3

Project No.	Description	To whom assigned	Report Due
61-10	Develop and test a means for recording instrument readings in an airplane cockpit continuously and automatically	I. R. Metcalf	April 1, 1938
61-11	Represent the Government's interests with respect to an existing contract with Mass. Institute of Technology for a blind landing instrument and system	I. R. Metcalf	Oct. 1, 1938

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AIRPORT SECTION PROJECTS

Project No.	Description	To whom assigned	Report Due
62-1	Determination of requisites for a transoceanic seaplane terminal	R. L. Campbell	Sept. 1, 1937
62-2	Develop and test a camera and means for its use to measure airplane performance near the ground	W. M. Aldous	Oct. 15, 1937
62-3	Compile a photographic record of all United States airports	J. B. Bayard	Jan. 1, 1938
62-4	Conduct a national survey of airport facilities and tabulate and chart results	J. B. Bayard	April 1, 1938

AIR TRANSPORT SECTION PROJECTS

Project No.	Description	To whom assigned	Report Due
63-1	Prepare a chart showing the elements involved in the safety and planning work of the Air Transport Section and the inter-relations of such elements	R. Humphreys	Sept. 10, 1937
63-2	Analyze the pilot fatigue problem	J. C. Edgerton E. E. Whitehead	Sept. 15, 1937
63-3	Represent the Government's interests in connection with an existing contract with Columbia University for research work dealing with the effect of altitude on pilots	R. Humphreys	Oct. 1, 1937
63-4	Study published airline accident reports, particularly those resulting in a finding of pilot error and determine contributory causes	J. C. Edgerton	Nov. 1, 1937

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EDUCATIONAL SECTION PROJECTS

This section is non-existent at present.

INTERNATIONAL SECTION PROJECTS

No special projects.

POWER PLANT SECTION PROJECTS

Project No.	Description	To whom assigned	Report Due
66-1	Study the existing contracts with Aircraft & Engine Development, Inc. for a barrel type engine and forumulate recommendations as to further action on this matter	J. H. Geisse	Sept. 1, 1937
66-2	Endurance test of Funk engine	J. H. Geisse	Sept. 15, 1937
66-3	Study power plant vibration and develop means and recommendations as to the application of such means for the prevention of propeller failures resulting from vibration	J. H. Geisse	Nov. 1, 1937

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RADIO DEVELOPMENT SECTION PROJECTS

Project No.	Description	To whom assigned	Report Due
67-1	Test Knoxville & Roanoke radio ranges to determine effects of counterpoises & simultaneous operation	D. M. Stuart A. E. Harrison	Aug. 15, 1937
67-2	Develop and test radio teletype communication means	J. C. Hromada P. D. McKeel R. A. Cunard	Oct. 1, 1937
67-3	Test a 125 Mc. transmitter to determine its suitability for use in air traffic control	W. E. Jackson J. C. Hromada E. S. Donovan	Nov. 1, 1937
67-4	Develop and test fan type radio marker	H. I. Metz J. M. Lee C. E. Jackson	Prelim. Sept. 1, 1937 Final March 1, 1938
67-5	Develop and test Z type and fan type radio marker receivers	P. D. McKeel J. C. Hromada H. I. Metz J. M. Lee	March 1, 1938
67-6	Develop and test Z type radio marker	H. I. Metz C. E. Jackson	Prelim. Nov. 1, 1937 Final April 1, 1938
67-7	Develop and test receiver for ultra-high frequency radio range	P. D. McKeel J. C. Hromada R. A. Cunard	May 1, 1938

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RADIO DEVELOPMENT SECTION PROJECTS - 2

Project No.	Description	To whom assigned	Report Due
67-8	Develop and test ultra-high frequency radio range	J. M. Lee C. F. Jackson R. A. Cunard J. C. Hromada S. E. Taggart	Prelim. Jan. 1, 1938 Final July 1, 1938
67-9	Develop and coordinate installation of radio instrument approach system	W. L. Jackson J. C. Hromada E. S. Donovan C. F. Jackson D. M. Stuart A. E. Harrison S. E. Taggart R. A. Cunard	Prelim. Aug. 20, 1937 Final Nov. 1, 1938

LIGHT RESEARCH

(At National Bureau of Standards)

Project No.	Description	To whom assigned	Report Due
68-1	Develop and test a flush type aircraft position light conforming with the requirements of the new Air Commerce Regulations for an airline position light	M. K. Laufer	Jan. 1, 1938
68-2	Study available aircraft landing lights and formulate recommendations as to regulations pertaining thereto	M. K. Laufer	Sept. 1, 1937
68-3	Develop and test suitable airport runway illuminators	E. C. Seaquist	Jan. 1, 1938
68-4	Study the optical qualities of rotating airways beacons with reference to the speed of rotation and the light intensity	G. K. Neiland	Prelim. Oct. 1, 1937 Final June 1, 1938
68-5	Determine the optimum specifications for aviation colors	W. R. Schaub	May 1, 1938

ALLOCATION OF 1938-39 APPROPRIATION BY SECTIONS

It is contemplated that the 1939 funds will be allocated among the various sections and activities of the Division as shown on the summary sheet following this page. This allocation is based on the best knowledge now available and we believe that it will be closely followed. It is desired however that sufficient flexibility be maintained to provide for readjustments between sections should contingencies arise which make such action advisable.

The item "Development Contracts" is to provide for research and experimental or developmental activities by agencies other than the Bureau of Air Commerce. Such contracts will result in reports or in specific articles of experimental equipment, or both. This activity, together with the allotment for the National Bureau of Standards, may be said to be the heart of the Divisions's functions.

The balance of the appropriation is for evaluating and coordinating the results of such research and putting them to practical use and for planning and initiating further research projects.

SAFETY AND PLANNING DIVISION
Estimated Budget for 1938-1939

Safety and Planning Appropriation Only

Section or Activity	Personal Services		Other Obligations					Total Estimated Obligations
	Dept.	Field	Equipment	Aircraft Purchases	Aircraft Operation	Development Contracts	Supplies	
Executive	$11,500	-------	-------	--------	--------	--------	$1,000	$ 12,500
Aircraft	11,000	$24,200	-------	--------	--------	$81,300	-------	116,500
Airport	41,420	123,360	$15,000	$45,000	$28,000	15,000	------	267,780
Air Transport	11,000	21,000	-------	--------	--------	48,900	------	80,900
Educational	6,400	2,600	-------	--------	--------	11,600	-------	20,600
International	6,400	5,800	-------	--------	--------	-------	------	12,200
Power Plant	7,400	8,400	-------	--------	--------	34,900	------	50,700
Radio Dev.	15,980	34,500	20,000	--------	--------	116,260	------	186,740
Flight Testing	-----	7,600	-------	60,000	10,800	-------	------	78,400
Light Research	-----	25,000	1,000	--------	--------	------	------	26,000
Lapses	-5,000	-10,000						-15,000
Subtotals	$106,100	$242,460	$36,000	$105,000	$38,800	$307,960	$1,000	$837,320
*Testing Station			55,000					55,000
TOTALS	$106,100	$242,460	$91,000	$105,000	$38,800	$307,960	$1,000	$892,320

*NOTE: This item not included in original budget statement - see page 56.

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PROGRAM FOR 1938-39

As will have been noted from the foregoing the most important work of the Division at present consists of a survey of the entire aviation industry for the purpose of tabulating and classifying all of its pressing problems so that they may be allotted places in a long-range plan looking to their solution in the order of their urgency and importance. This work has just been started and we feel that it would be most unwise to attempt to anticipate its results at the present time in connection with the 1938-39 program.

There is, of course, a great deal of study and development work to be done in the wide-spread field of the aeronautical sciences. It is the vastness of this field of urgently needed work which makes it advisable for us to complete a careful survey before deciding upon a definite program because we cannot hope to accomplish the entire job with the funds requested and are, therefore, anxious to evaluate and work on the most urgent projects. To illustrate this point there has been compiled, on the following pages, a series of lists and descriptions of this Division, starting at the earliest possible date. These lists will be added to and rearranged as to order of importance as a result of our survey.

AIRCRAFT SECTION PROJECTS

There follows a list of projects which it is believed the survey now being conducted will show should be undertaken by the Aircraft Section. In this connection it should be borne in mind that a number of projects are continuous from year to year and further that each of the following classifications includes numerous subclassifications, all of which must be investigated:

1. Projects looking to the prevention of dangerous formation of ice on aircraft.

2. Although such projects are now being carried out, the rapid advance in aircraft design and performance will render further and continuous studies necessary.

. Projects looking to the prevention of accidents due to lightning striking aircraft in flight.

3. Projects looking to the determination of and elimination of dangerous vibration in aircraft components.

   These projects are extremely important from the point of view of insuring safety and the promulgation of regulations to insure safety. Of prior importance is the study of the complex vibration phenomena present in power plant installations.

   This problem must be attacked at once and some projects will be started this year but such projects will continue into next year and probably the following years.

4. Allied with the vibration projects are projects having to do with the elimination of flutter.

   Flutter problems are recurrent due to the continual advances in aircraft design and performance. Needless to say, the elimination of flutter is a very important matter.

5. The vibration projects will produce instruments of the strain gauge type which can be used to great advantage in determining stresses present in aircraft structures. To assist manufacturers and the Aircraft Airworthiness Section, this matter will be followed up and definite projects carried out.

6. Projects, in cooperation with the N.A.C.A., dealing with the practical application of the results of that Committee's fundamental researches in both aerodynamics and aircraft structures with a view to furnishing the aircraft manufacturers with information which may be used directly in their design and furnishing the Aircraft Airworthiness Section with information on which to base airworthiness requirements.

   Such projects will have to do with subjects such as Airloads on Aircraft, Effects of High Lift Devices on the Structure and on Performance, Monocoque Design Research, Flying Boat Hull Research, etc., etc.

7. Projects, in cooperation with the N.A.C.A. and the National Bureau of Standards, to determine properties and characteristics of new materials suitable for aircraft use.

   In this connection, the use of plastic materials offers many advantages but very little is known concerning these materials.

8. Projects dealing with the front-wheel tricycle type landing gear.

   It is apparent that this type of landing gear, because of its manifold advantages, is becoming increasingly popular. The Aircraft Airworthiness Section already is embarrassed due to the lack of airworthiness requirements for this type of landing gear. Such requirements, therefore, must be promulgated as soon as possible.

9. Projects looking to the development of essential instruments and the improvement of existing instruments.

   Such a project is now being handled and is that of reproducing in the aircraft cockpit a properly orientated chart of the airport being approached by the aircraft.

   Future projects will include the following:

a. The development of an absolute altimeter. The need for such an instrument becomes more and more apparent as the art of instrument flying progresses.

b. The determination of the proper installation of airspeed indicators to eliminate the errors now existing through improper installation.

c. Determination of the proper method of divorcing the altimeter from the airspeed indicator to allow calibration of each airspeed indicator with respect to the airplane in which it is installed without introducing errors in the altimeter.

The improvement of instruments, of course, is an example of a continuous project.

10. Projects looking to the obtaining of essential flight records automatically.

The present project of developing an automatic instrument log will lead to other developments along this line.

11. Projects having to do with blind landing systems, in cooperation with the Radio Development Section.

The present project of developing a blind landing instrument and system probably will show relationship between the instrument and other systems being developed.

12. Projects, in cooperation with the Air Transport Section, dealing with aircraft design problems arising from that section's endeavors to reduce pilot fatigue and increase passenger comfort.

Such projects will include the study of aircraft design problems incident to high altitude flight, such as the development of supercharged cabins.

13. High altitude flight also introduces aerodynamic problems which must be studied and information obtained for the use of aircraft manufacturers and the Aircraft Airworthiness Section in promulgating regulations concerning this type of flight.

14. Projects looking to the improvement of aircraft lighting, in cooperation with the National Bureau of Standards.

    These projects will include the following:

    a. Landing lights. Requirements for landing lights must be promulgated and recommended to the Aircraft Airworthiness Section.

    b. Position lights. Present position lights are not sufficiently effective and an entirely new system has been suggested. Present position lights also tend to increase ice formation. A great deal of research and development work is necessary in this field.

    c. Instrument lights. Some work is necessary yet to develop proper instrument lighting.

15. A thorough study of parachute problems with a view to revising the Bureau's requirements pertaining to parachutes, parachute riggers, and exhibition parachute jumps.

16. A thorough study to determine the procedure the Bureau should follow in the matter of licensing airplane and engine mechanics.

17. Projects looking to the assisting of glider builders and pilots.

    The present study of the proposal of the Soaring Society of America that the Bureau should issue a glider handbook probably will lead to other projects concerning this subject.

18. Projects initiated as a result of a thorough analysis of accident reports and mechanical interruption to flight reports.

It is, of course, impossible to enumerate these projects until the analysis is under way. This is another example of a series of projects which will continue from year to year.

19. With larger aircraft being built every year the problem of adequate airports is becoming increasingly acute. It is probable that at least a partial solution lies in some sort of launching device. This subject should be given intensive study.

20. The continuous study of all ideas and inventions submitted to the Bureau and projects initiated as a result of this study.

The number of ideas and inventions submitted to the Bureau is very great and all of these must be carefully studied to preclude the possibility of a promising idea or invention being lost to the industry. Any promising idea or invention should be developed sufficiently to show definitely whether or not it is of practical value. The Bureau, in such cases, should assist in the development by such means as are possible.

AIRPORT SECTION PROJECTS

The work of this section is somewhat different than that of other sections of the Division in that it is of a recurring nature. It was possible, therefore, to describe this activity in detail in the general justification and that was done.

AIR TRANSPORT SECTION PROJECTS

The following list illustrates the type of work assigned to the Air Transport Section:

		Estimated Cost
1.	PILOT MEDICAL RESEARCH	
	Includes research and study relative to physical and mental requirements prior to certification, periodical examination requirements, factors contributing to fatigue, fatigue results and remedies therefor. Anticipate contractural arrangements with flight surgeons especially qualified in this particular field of physiology and psychology.	$35,000
2.	PASSENGER HEALTH AND COMFORT	$10,000
	Involves experimental research to determine safe attainable altitudes with reference to oxygen requirements and lowered air pressures. Includes study covering supercharging devices to maintain proper oxygen content in the air and proper pressure within the cabin. Includes study as to correct cabin equipment and furnishings to provide maximum passenger relaxation during long flights, also investigation as to proper kinds and amounts of foods to be served aloft. Experimental apparatus including decompression chamber, and physician's services will be needed in the prosecution of this important study.	
3.	ANTI-STATIC RADIO HEARING DEVICE	1,500
	Some progress presently made in this field. Experiments under way and will continue with reference to application of bone conduction method of receiving radio range signals and voice messages, thereby reducing to a minimum static interference and the annoyance experienced in the present air-conduction method. Involves actual flight tests and procurement of additional apparatus. No outside personal services required.	

Estimated Cost

4. POLARIZED LIGHT — $1,000

Study, research and experiments in effort to eliminate the hazard and discomfort of glare emenating from reflected sunlight and from illuminated instrument panels. Solution probably lies in application of a newly discovered method of treating glass in a manner causing it to polarize light rays.

5. AIRWAY BEACON SURVEY — -------

Study and research coordinated with that of the Bureau of Standards to determine the most practicable means of airway beacon marking. Involves experiments in comparing high powered widely spaced beacons with lower powered beacons spaced at more frequent intervals and other details of this particular form of illumination. A subject of increasing importance resulting from scheduled airline speeds having been doubled within the past five years and since the installation of a majority of presently existing airways beacons. Preliminary reports now available but much follow-up work is needed.

6. RADIO FAN TYPE MARKER SURVEY — -------

Securing the proper advice from reliable sources as to installation of this navigational aid at points needed and presently not adequately marked, particularly in mountainous regions.

7. DEAD RECKONING AVIGATION — -------

Determine the permissible periods of time during which pilots will be allowed to fly on instruments in the event of radio range failure or ineffectiveness. Involves detailed investigation of flight instrument efficiency, prevailing meteorological conditions in specified areas and terrain conditions where failures are most likely to occur. Will probably require some regulation revisions.

8. OXYGEN INHALING APPARATUS — --------

In view of the fact that it will in all probability be found necessary to administer oxygen to the crew and passengers on scheduled airline flights if schedules continue to be pushed upward, contacts must be established with manufacturers of oxygen inhaling apparatuses looking to the prompt development of practicable devices for this purpose.

Estimated Cost

9. SPACING OF AIR LINE SCHEDULES ------

Effort to bring about coordination of scheduled departures and arrivals of air line aircraft at controlled and non-controlled airports to the end that collision hazards may be reduced to a minimum. Proper spacing and some readjustments can profitably be made.

10. AIRCRAFT ACCIDENT SURVEY -------

Intimate and detailed study of all aircraft accidents attributed to pilot error or technique with the view of uncovering causes of error; whether fatigue, lack of experience, mental disturbance or temporary physical impairment. Desirable to use major portion of one employee's time in proper investigation of such accidents of which there are too many.

11. FIRST AID KITS AND EMERGENCY EQUIPMENT -------

There are many divergent opinions as to the best type of first aid kits and other emergency equipment which should be carried in aircraft. It is felt that an effective set of specifications for various classifications of operation should be initiated.

12. INSTRUMENT COMPLEXITY --------

With the advent of substantially larger aircraft the solution of the problem of instrument installation has been difficult. Extensive study should be employed, particularly in view of the fact that four-engine airplanes are near, to the end that instrument arrangement and illumination may relieve pilots of a considerable amount of unnecessary work and eye strain. Manufacturers will cooperate with the Bureau in attempting a solution of this difficulty.

13. AIR TRAFFIC CONTROL --------

There is set up for the Air Transport Section the position of Air Traffic Specialist whose duty it is to follow the activities of the Operation Division in this regard. The proper coordination of many of the anticipated research activities of this section with Traffic Control will require the full-time services of such an employee whose duty it will be to participate in the solutions of many weighty problems already recognized and which will become increasingly complex with additional scheduled and non-scheduled flying.

Estimated Cost

14. GROUND PERSONNEL SURVEY -----

A considerable amount of study is needed with reference to the training of ground personnel whose duties are incident to the control and dispatching of aircraft. While less spectacular than air personnel, their functions are of the utmost importance. Survey as to actual requirements before such personnel are certificated in their respective positions is needed.

15. COORDINATION OF PILOTS' DUTIES -----

Initiate, through cooperation with air lines, a uniform procedure with reference to the practicable sharing of cockpit duties of pilots. There have been occasions in the past when a lack of complete understanding between pilot and copilot as to their respective functions have resulted in critical conditions. This will be further complicated next year when an additional member is added to the crews of the larger aircraft.

16. USE OF PARACHUTES ------

In connection with non-scheduled flights the proper application of this safety device is most important. Additional research along this line may develop revised regulations as to its use.

17. ADDITIONAL USES FOR AIRCRAFT -----

Present uses seem to be well established in regular channels of commerce and private use. It is felt that through experimentation and research, new developments may uncover additional fields for aircraft's practical use such as economical transportation of perishables and other specific freight cargoes, air ambulances, etc.

18. AIRCRAFT DESIGN PROBLEMS ------

The Air Transport Section will of necessity cooperate closely with the Aircraft Section with respect to those problems of aircraft design which are related to both sections.

Estimated Cost

19. QUARANTINE RESTRICTIONS -------

With increasing international air operations it is essential that additional precautions be taken at ports of entry relative to passengers' physical condition. It is believed that prolonged flights at high altitudes produce flare-ups of infectious disorders ordinarily difficult to detect. Physiological research in this field by competent physicians is and will continue to be needed from the standpoint of national protection.

EDUCATIONAL SECTION PROJECTS

The Educational Section will work in close cooperation with Federal Educational agencies and with State and Municipal bodies with reference to matters of aviation education. This work will involve at least the following activities:

1. Compile and keep currently accurate a list of schools giving aviation courses, academic or trade, such list to classify type of instruction and degrees or certificates given.

2. Determine the type and number of school-trained employees needed in the aviation industry.

3. Compile and disseminate results of studies looking to coordinating the number of students and the types of instruction with the needs of the industry.

4. Work toward similar types of instruction for comparable degrees or certificates in the various schools.

5. Interest under-graduates or post-graduate students or instructors in special aviation research studies needed in connection with the work of the Safety and Planning Division and make arrangements therefor.

6. Determine the needs of the schools as to accurate aviation teaching material and take steps to secure such material for them.

7. Obtain information relative to aviation educational systems and methods used in other countries and determine if the United States may profitably use similar procedures.

8. Assist the faculties of aviation schools in obtaining competent teaching personnel.

INTERNATIONAL SECTION PROJECTS

The year 1937 marks the first decade of civil aviation in the United States, which has grown from a rough experiment into one of the greatest means of transportation in the world. This country leads all foreign countries in the manufacture and operation of commercial aircraft and has set a precedent whereby operating lines of other nations are utilizing American aircraft equipment and accessories in their daily operations. Since domestic civil aviation in the United States has grown, expanded and now covers every corner of this country, it is only natural that the industry should look to other fields. In this regard, the international picture on aviation begins to take shape and offers many possibilities for a new field of aeronautical adventure.

As domestic aviation grew in the United States, it was necessary for the Bureau of Air Commerce to grow and expand its activities accordingly in order to keep pace with aeronautical development. The Bureau of Air Commerce is faced with a similar situation as the international aeronautical problems increase, and in this regard it becomes necessary and essential to cope with the situation by establishing an International Section in order to act as the key to the international aviation situation.

The functions of this section are indicated in the following tabulation, and as work progresses, there will be many new phases of the work developed and new functions created.

In order to intelligently carry out these functions in the best interest and benefit of the Government, and to accomplish the purpose contemplated, it is necessary that sufficient funds be appropriated. The 1938 appropriation allowed this section to establish an office that would take care of the immediate needs of international aeronautical activities. This office will study aeronautical developments of foreign countries and will centralize aviation information for distribution to the various offices of the Bureau of Air Commerce requiring this data. By the end of the 1938 fiscal year this office will be well established and in a position to expand and carry on its work. It will become more involved in international problems, as aviation grows, which will require an increase in office and personnel activities. This section will:

1. Secure complete information in detail for the Bureau of Air Commerce concerning:

   (a) All foreign and other International Air Transportation systems.

   (b) The method and degree of Government subsidy of various European and South American Air Lines.

   (c) The amount of capital invested in each operation and Division of ownership thereof.

   (d) The types of aircraft, accessories and general equipment used.

   (e) The total of personnel employed, by classifications.

   (f) Flight time limitations for pilots and other crew personnel.

   (g) Maintenance methods, procedures and equipment used. (The details of government regulations governing operation).

   (h) The extent and type of Navigation facilities supplied by the Government and by the individual operators, including all information on meteorological facilities and methods used.

   (i) All general information as to technique of operation, training and control of personnel, etc.

   (j) Physical standards required. Frequency of physical and professional qualification examinations.

   (k) In general, all information that can be acquired relative to every phase of civil aeronautics. the extent thereof, the rate of growth, and the probable expansion, with particular reference to plans for the future in connection with national and international expansion that may possibly affect the United States from the standpoint of air transportation as well as from the standpoint of expansion of commerce.

2. Gather and transmit to the Bureau of Air Commerce, all available information for use in establishing or revising reciprocal agreements between the United States and other Nations in matters pertaining to civil aeronautics.

3. Gather and furnish the Bureau of Air Commerce with all available technical information as to new developments in aircraft, engines and propellers, and all aircraft accessories, including radio.

4. Represent the Secretary in conferences held abroad, relating to civil aeronautics.

5. Cooperate with all United States foreign representatives with reference to the expansion of foreign markets for American civil aircraft and accessories.

6. Represent The Secretary with foreign purchasers of American aircraft in matters relating to questions that arise from time to time, particularly with such large purchasers of American aircraft as the K.L.M. of Holland.

7. Maintain a close contact and cooperate with the foreign aeronautical offices of the various Departments of the United States Government. The following are some of the organizations that will be contacted and with which a working agreement will be established.

   (a) Maritime Commission
   Aeronautical Section
   Aeronautical Advisor, Grover Loening.

   (b) Department of Commerce
   Foreign and Domestic Commerce
   Aeronautics Trade Section. Chief,
   Brower V. York.
   Assistant Trade Commissioner B. T. Benson

   (c) National Advisory Committee for Aeronautics

   (d) National Aeronautical Association

   (e) National Aeronautical Chamber of Commerce

   (f) Foreign Embassies and Legations.
   (Air Representatives).

   (g) Foreign Offices of International Operators.

(h) State Department.
(Mr. Murphy, Consul in the State Department is Liaison Official between State and Commerce.)

(i) War Department
(Air Attaches in foreign countries.)
(G-2, in Washington.)

(j) Navy Department
(Air Representatives in foreign countries.)
(Office of Naval Intelligence, Washington.)

(k) Treasury Department
(Coast Guard Service.)

(l) Post Office Department
(Foreign Air Mail.)

POWER PLANT SECTION PROJECTS

It is estimated that a sum of $300,000 could well be spent by the Power Plant Section alone. We are requesting only approximately one-sixth of that amount at the present time inasmuch as the budget for other activities of the Division is also comparably less than would be desirable, but the need for such work is well illustrated by the following tabulation of the activities which should be undertaken in this field:

1. Inventions: The Bureau of Air Commerce is the sole Government agency authorized to assist in the development of inventions of interest to commercial aeronautics and as such is besieged with requests for assistance. To render assistance in those cases relating to power plants when such assistance is warranted, an allotment of $75,000 should be set up. ---------- $ 75,000

2. Engines: There are two major development projects which should be sponsored by the Bureau.

   (a) One is the development of oil engines in which this country now trails the world. The National Advisory Committee for Aeronautics has spent much time and money in research on this subject but it is not authorized to go beyond the research stage. The results of its research have not as yet been reduced to practical application in aeronautics and this should be done. In this connection new forms of engine construction especially adapted to the Diesel cycle should be developed to reduce the weight of such engines. ---------- $ 100,000

   (b) The second major problem is that of reducing the costs of engines for private flying. New forms of engines should be encouraged where they result in a cost reduction. The two-stroke cycle engine offers exceptional possibilities of accomplishing the desired result and its experimental development should be fostered. Again the National Advisory Committee for Aeronautics in its own laboratories and at the Massachusetts Institute of Technology is making definite progress toward the solution of those problems which can be classified under the heading of research but beyond this point it cannot go. ---------- 60,000

17981

(c) The results so far attained with the barrel type two-stroke cycle engine under Bureau Contract No. 36-5696 warrant a continuation of Bureau assistance in this development, including its application to operation on the Diesel cycle. ---------- $30,000

3. Accessories: The costs of power plant accessories are inordinately high. A thorough study should be made of the application of the products of other industries to aviation use. Frequently such possible applications are called to our attention but they cannot be used until they have been subjected to thorough proving tests. The aviation market as compared to the automotive market is so insignificant that the manufacturer of such articles is not sufficiently interested to make such tests. To carry on such an investigation and to conduct the necessary tests: ---------- 10,000

4. Cooperation with Airworthiness Section: The Airworthiness Section frequently has problems of licensing which can only be answered by the conduct of special tests, the cost of which cannot be justifiably placed on others. To carry on tests requested by this section: ---------- 15,000

5. Investigations and experimental work looking toward the reduction of fire hazard in aircraft power plants ---------- 10,000

TOTAL ---------- $300,000

RADIO DEVELOPMENT SECTION PROJECTS

There follows a partial list of the projects demanding the attention of the Radio Development Section:

1.	Construction of an experimental radio range and broadcast station in the vicinity of Washington where problems of radio range operation may be investigated without interruption of range service on existing airways. ----------	$46,000
2.	Development of equipment for ground to aircraft radio teletype operation which will permit teletype broadcasts of weather and other information to aircraft in flight. ----------	17,000
3.	Purchase and install equipment for an instrument landing system in accordance with the specifications prepared by the RTCA subcommittee which has been studying instrument landing systems, and sponsor further service tests on this system. ----------	50,000
4.	Experimental and development work on the use of ultra high radio frequencies for radio range, and ground to aircraft radio telephone service. --------	25,000
5.	Testing of newly developed commercial radio equipment having an application in the field of air navigation. ----------	15,000 per yr.
6.	Preparation of specifications for equipment and planning for location and installation of a multichannel radio teletype system on established airways. ----------	20,000
7.	Make an aerial field intensity survey of the United States to determine the maximum tolerable interference between radio range stations under operating conditions, and to establish a scientific basis for determining safe geographical and frequency separations of airway radio facilities. ----------	14,000
8.	Research and development work toward improvement of existing airway radio facilities. ----------	20,000 per yr.
9.	Sponsor and direct further research work on the elimination of precipitation static. ----------	25,000
	TOTAL ----------	$232,000

FLIGHT TESTING

It is obviously impossible for the Division to perform tests of aircraft and airway equipment unless adequate aircraft are available for the test flight work involved. The only aircraft presently available to the Division for this purpose is an obsolete and under-powered model which has such poor performance as to be too dangerous for some of the work involved. This airplane is also too small to carry the personnel and equipment needed for a large proportion of the test flying. A specific case at hand involves medical observation, including blood tests, of individuals at high altitude in aircraft in connection with our pilot fatigue studies. This work cannot be done with the airplane now available. For work in connection with radio static, lightning, simplification of existing cockpit complexities, ice prevention and similar studies also it is essential that we have a modern, high-speed two-engine airplane.

We therefore propose to purchase the most economical two-engine, high-speed airplane which we can obtain and in addition will need at least one other smaller, single-engine airplane. The item of $60,000 is included in the budget for these purchases. If this sum proves to be sufficient we will also purchase a third small airplane so that our present one may be retired.

The budget provides for two test pilots to fly these airplanes. Since several members of our staff are pilots and can if necessary perform some of the less hazardous flying, it is believed that two test pilots are sufficient.

LIGHTING RESEARCH

It is believed that this subject is comprehensively explained in the general justification. It might be well to add, however, that the services of the skilled scientists of the National Bureau of Standards are absolutely essential to the Bureau of Air Commerce in connection with this important subject of lights.

TESTING STATION

The item of $55,000 listed under the title of "Equipment-Testing Station" is an additional item which was not included in the Budget Estimate formerly submitted. The reason for this omission and the need for this item will appear in the following discussion.

The need for a testing station or proving ground for new aircraft and airway devices was explained in the supplemental justification for the 1937-38 appropriation and further explanation appears in the general justification for the 1938-39 budget. In spite of the fact however that the Congress clearly intended this project to go forward in 1937-38 the Appropriation Act contains no specific authorization therefor. It appeared to us, upon reading the act, that a small part of the appropriation "Establishment of Air Navigation Facilities 1937-38" could appropriately be used for the purchase of land and the erection of the necessary buildings for this purpose and such action was intended at the time the 1938-39 budget was originally drafted. Being extremely desirous, however, of conforming exactly with the intended provisions we have since instituted a careful investigation on this point which indicates that, if such purchases are allowed under the 1937-38 act they will of necessity be charged against the appropriation "Safety and Planning". The drastic reduction made in that appropriation below the amount which was estimated as necessary will, however, effectually prevent an expenditure greater than that necessary to acquire the land and condition it for use. The amount requested for 1938-39 will, therefore, be necessary for the erection of hangar and shop facilities and for the installation of the other testing facilities contemplated. It is felt that this project is of special importance and is an urgent duty of the Government.

ALLOTMENT OF PERSONNEL

The personnel contemplated for each of the various sections is shown on the chart following. The very small size of all of these sections with respect to the wide scope of their activities is self-evident and indicates the sincere intent of the Bureau to accomplish the maximum possible performance with a modest budget.

SAFETY AND PLANNING

Allocation of Personnel Fiscal Years

1939 and 1938

Section	1939	1928
Executive	3	3
Aircraft	10	7
Airport	62	3.5
Air Transport	9	6
Educational	3	
International	4	3
Power Plant	3	2
Radio Development	19	14