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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION AUTHORIZATION

HEARINGS

BEFORE THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

NINETY-EIGHTH CONGRESS

FIRST SESSION

ON

NOAA OCEAN AND COASTAL PROGRAMS; THE NATIONAL MARINE FISHERIES SERVICE; AND ATMOSPHERIC AND SATELLITE PROGRAMS

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people such as yourselves. I will write a letter to the Secretary of Commerce urging that the three people here be provided with a copy, and perhaps you could give your comments after reading it. And I would hope that the administration will take into account this study that floated into my office somehow.

And, incidentally, I have legislation that I introduced which would prohibit the transfer of the satellite without congressional authorization. But I do think it is something that we need to get out into the public domain.

Dr. HOSLER. Mr. Chairman, you have two witnesses here in the room who are experts on this satellite business that could shed more light on it than perhaps we can.

Senator TRIBLE. Perhaps it is time to call them forward. If my colleague, Senator Pressler, has no further questions, gentlemen, I thank you for your presence today and for your very fine testimony. There are a number of other questions that I would like to propose today but because of time constraints I would like to submit those to you for the record.

Again, thank you very much.

We have a second panel today on satellite programs, Dr. David Johnson and Dr. Verner Suomi. Good morning, gentlemen, and welcome. Again, may I say that we will make your full statement a part of the record and we would encourage you to summarize that statement or make further observations that may have been brought to mind by the testimony you have heard today. We welcome you.

STATEMENTS OF DR. DAVID JOHNSON, UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH, AND DR. VERNER SUOMI, PROFESSOR OF METEOROLOGY, UNIVERSITY OF WISCONSIN

Dr. JOHNSON. Thank you, Mr. Chairman. I am certainly pleased to be asked to comment on the proposed NOAA budget for 1984 as it relates to the Nation's weather satellite program. As the former Assistant Administrator of NOAA for satellites, I have more than a passing interest in the subject.

Since retiring from NOAA over a year ago, I have been working as a consultant to the Secretary General of the World Meteorological Organization, which has been mentioned by one of the previous witnesses. This is a specialized agency of the United Nations. I am consulting on maintaining and improving the world weather watch. This is the cooperative network, that Peter Leavitt mentioned for the exchange of weather data among all the Nations of the world.

I am also serving as special assistant to the President of the University Corporation for Atmospheric Research, UCAR, which is a consortium of 50 universities that have graduate programs in atmospheric and related sciences. I want to emphasize that I am appearing here in my personal capacity. However, this recent experience has broadened my view of the importance of the satellite system beyond the needs of the U.S. Government.

In particular, I was asked to comment on the administration's proposal to reduce the NOAA polar-orbiting satellite system from the present two-spacecraft system to one. In summary, I think such

a reduction would be disastrous not only to the weather services of the United States, but to the many nations of the world which have become dependent on this important source of global weather data.

The compelling reason for a two-satellite system is not the increased data available from double coverage, valuable as this may be. The primary motivation is the need for an inorbit backup. With two satellites in orbit, when one fails, the other is still available.

I might make an aside here that the decision to go to the present two-in-orbit system was reached in, I believe, 1972—it may have been 1973—as a cost-saving maneuver. Up until that time, NOAA operated a single polar orbiter, but there were redundant systems onboard. It was sort of like Noah's Ark; you had two transmitters, two cameras, two of everything, so that when one of them failed, you could switch to the backup unit and then proceed with launching a replacement, thus avoiding an interruption in service.

At that particular point in time, the decision had been made to introduce a new spacecraft which had vastly improved capabilities over the model that had been used up until then. In order to build the new spacecraft, NASA included in its budget a significant amount of money to design and test this new model, the first of a kind. Subsequently, then, NOAA would pay the cost of building operational versions.

So in order to save the money of that one-time investment in the design of a new spacecraft, NOAA and NASA were then directed by the administration to use a spacecraft that had been designed for military purposes and adapt it for the weather mission.

The engineering design of that spacecraft, while it did save the one-time investment, forced NOAA to operate at a lower altitude and with a smaller payload than was planned; thus, you had to launch two spacecraft to provide the complete global coverage, as well as have what we call a fail-soft system. That is, when one spacecraft failed, you still had another that provided most of the global coverage, and you could wait, then, the 4 months or so to launch the replacement.

Now, the new plan calls for a launch on a fixed schedule every 18 months, regardless of the status of the inorbit satellite. Thus, if there were premature failures of the NOAA spacecraft in orbit or the premature failure of one spacecraft followed by a launch failure, there could be a complete cessation of global satellite coverage for a long period of time.

Mr. Winchester said that there was little possibility that this would happen. However, it should be recognized that the NOAA operational satellite system has, in the past, suffered both launch failures and premature inorbit spacecraft failures. So I think if one looks at the record, one would see that indeed, it has a high probability of occurring. The only question is when, and no one can make that prediction.

The polar-orbiting satellites make important contributions to weather forecasting. They not only cover the polar regions, but also provide vertical temperature and moisture soundings over the whole Earth, including inaccessible areas. What would be the impact of a policy to provide only one polar orbiter instead of the two-spacecraft system we have employed so successfully? The most

likely result is that a failure of this single polar orbiter or a launch failure would leave us without observations, perhaps for several months, until a replacement could be launched. This key element of the global weather-observing system would collapse with catastrophic results.

Just visualize a time gap with no observations; how are you going to make adequate forecasts? While it is true that there are other data, by far the largest percentage of the total global weather observations comes from this pair of satellites. The whole international weather monitoring structure would be compromised; especially the remote atmospheric sounding measurements made from space, and the location and collection of data from drifting ocean buoys, balloons, and other automatic observing units in remote places. We will have intolerable gaps in our global data base which will impact both operational weather forecasting and some research, such as the global climate program that has been mentioned by Professor Fleagle and will be mentioned by Professor Suomi.

The impact of the total loss of polar satellite coverage would be catastrophic to many other nations as well. More than 100 countries have ground equipment to receive data broadcasts directly from these NOAA satellites. In many developing countries, these data represent the primary source of regional weather observations.

The sounding data that I mentioned earlier are used internationally in numerical weather forecast models which provide basic forecasts of global circulation and weather systems. So it is not just the U.S. weather services that are dependent upon these for the forecast models. This is part of the World Weather Watch that I mentioned, which is being coordinated and planned under the aegis of the WMO. Indeed, the Commission for Basic Systems of the WMO at its meeting in February stated that these satellites are an essential part of the world weather watch. Many feel that without the polar-oribiting satellites on a reliable basis, there indeed would be no world weather watch.

I could go on further about the international aspects. I would like to point out that there are a number of satellites operated by other nations and consortia of nations that contribute to the total weather satellite picture of the world. For example, Japan by itself operates a geostationary operational satellite, India has launched one such satellite that also serves for communications and television purposes. Unfortunately, it failed after a brief time, but they are planning to launch a replacement. The European Space Agency, on behalf of the European nations, operates another geostationary satellite. Even the U.S. polar orbiters that we are talking about have some systems that are contributed by European countries. Both the United Kingdom and France contribute, at no cost to the United States, important subsystems that are used in this observing program. So the global nework of satellites already has many aspects of an international program.

While there may be a possibility of encouraging greater contributions to the U.S. effort from other countries, I think that we have to be aware of the large contribution already being made.

In conclusion, I would like to say that the proposed changes in the U.S. operational weather satellite system, including commercialization which has been proposed, should not be considered as a domestic issue only. This Nation should and does have a responsibility in the larger community of nations. This community should be involved in finding responsible alternatives if, indeed, the United States no longer is in an economic position to continue financing the present system upon which the world has become so dependent.

Thank you, Mr. Chairman.

[The statement follows:]

STATEMENT OF DR. DAVID S. JOHNSON,[1] UNIVERSITY CORP. FOR ATMOSPHERIC RESEARCH

Mr. Chairman and members of the Subcommittee, I am pleased to be asked to comment on the proposed NOAA budget for FY 1984 as it relates to the nation's weather satellite program. As the former Assistant Administrator of NOAA for Satellites, I have more than a passing interest in the subject. Since retiring from NOAA over a year ago, I have been working as a consultant to the Secretary-General of the World Meteorological Organization (WMO), a specialized agency of the United Nations, on maintaining and improving the World Weather Watch, and as a special assistant to the President of the University Corporation for Atmospheric Reasearch (UCAR), a consortium of 50 universities. While I am appearing here in my personal capacity, this recent experience has broadened my view of the importance of the satellite system beyond the needs of the U.S. Government.

In particular, I was asked to comment on the Administration's proposal to reduce the NOAA polar orbiting satellite system from the present two-space craft system to one. In summary, I think such as reduction would be disastrous, not only to the weather services of the United States, but to the many nations of the world which have become dependent on this important source of global weather data.

The compelling reason for a two-satellite system is not the increased data available from the double coverage, valuable as this may be. The primary motivation is the need for an in-orbit back-up. With two satellites in orbit, when one fails the other is still available. When a polar orbiter fails, present operating procedures call for a second weather satellite to be launched as soon as possible. This takes a minimum of four months when an expendable launch vehicle is used; it would take much more time with a shuttle launch. If there should be launch failure, present operating procedures call for a third weather statellite to be launched, and the process continues until two operating satellites are again in orbit. With this type of operational plan, the United States has been able to maintain at least one operating polar-orbiter in space at all times.

The new plan calls for a launch on a fixed schedule, every 18 months, regardless of the status of the in-orbit satellite. Thus, if there were premature failures of the NOAA spacecraft in orbit, or the premature failure of one spacecraft followed by a launch failure, there could be a complete cessation of global satellite coverage for a long period of time. It should be recognized that the NOAA operational satellite system has in the past suffered both launch failures and premature in-orbit spacecraft failures.

The polar-orbiting satellites make important contributions to weather forecasting. They not only cover the polar regions, but also provide vertical temperature and moisture soundings over the whole earth in inaccessible areas, including the data sparse oceans. What would be the impact of a policy to provide only one polar oribter instead of the two-satellite system we have employed so successfully? The most likely result is that a failure of this single polar orbiter or a launch failure would leave us without observations—perhaps for several months—until a replacement could be launched. This key element of the global weather observing system would collapse, with catastrophic results. For example, we would have zero atmospheric sounding coverage over most of the oceans. Storms, including hurricanes, come to us from the Pacific and the Atlantic.

[1] These remarks are made in Mr. Johnson's personal capacity and do not represent the views of the University Corp. for Atmospheric Research or the World Meteorological Organization.

The whole international weather monitoring structure would be compromised, especially the remote atmospheric sounding measurements made from space and the location and collection of data from drifting ocean buoys, balloons, and other automatic observing units in remote places. We will have intolerable gaps in our global data base which will impact both operational weather forecasting and some research such as the global climate program.

The impact of the total loss of polar satellite coverage would be catastrophic to many other nations as well. More than 100 countries have ground equipment to receive data broadcasts directly from the NOAA satellites. In many developing countries, these data represent the primary source of regional weather observations. The sounding data I mentioned earlier are used internationally in numerically weather forecast models which provide basic forecasts of global circulation and weather systems. This is part of the World Weather Watch under the aegis of the WMO. Indeed, the Commisssion for Basic Systems of the WMO states that these satellites are an essential part of the World Weather Watch.

Thus, proposed changes in the U.S. operational weather satellite system, including commercialization, should not be considered as a domestic issue only. This nation should and does have a responsibility in the larger community of nations. This community should be involved in finding responsible alternatives if, indeed, the United States no longer is in an economic position to continue financing the present system upon which the world has become so dependent.

[The following information was subsequently received for the record:]

QUESTIONS OF THE COMMITTEE AND THE ANSWERS THERETO

Question. You and other experts have stated that the primary rationale for a two-satellite system is the need for an in-orbit backup. The Administration argues that polar satellites are usually operational for 2 years and that the possibility of failure is minimal. (a) Given the different views on this matter, don't you think that a study on the effects of a one versus two-polar satellite system on weather forecasts is in order? (b) Could you estimate what such a study would cost?

Answer. I do not believe at issue is the question of the importance of polar satellite data on weather forecasts. The question is will there be a complete interruption in the coverage by polar satellites with the proposed reduction to a one-satellite system? One could perhaps do an independent and objective study of the probability of a total system failure. As I understand it, the Administration believes the risk is minimal. However, based upon demonstrated lifetime of spacecraft, and the record of launch failures to date, I believe the probability of failure is too high. It should be possible to calculate rather quickly what the probability is, based upon past performance of NOAA, and similar NASA and DOD spacecraft and launchings.

The simple type of calculation described in the answer to question 1.(a) should require no more than one or two months' time of a competent analyst at a cost of $10,000–$20,000.

Question. You state that NOAA satellites have suffered launch and in-orbit failures. (a) With the new plan that calls for satellite launches on a fixed schedule of every 18 months, what impact will this have on weather and climate services? (b) what was the former schedule?

Answer. The main impact of a fixed schedule of launches every 18 months comes if there is a sequence of premature spacecraft failure and a replacement launch failure. As I indicated in my testimony, such a sequence could result in no polar satellite data being available at all for a period of several months and perhaps more than a year. With this possibility, most meteorological services cannot depend upon the polar orbiter in planning their operations. If they cannot count on it they cannot depend upon it. Alternate, albeit inferior, methods of acquiring weather data would have to be arranged. In large areas of the world, there are no economically feasible alternate methods. As Professor Suomi pointed out in his testimony, large data gaps in the record of climate would seriously compromise our ability to study and detect climate change.

Under the former (present) schedule, two satellites are kept in orbit at all times. When one of the satellite fails, a new replacement satellite is launched. The time from failure until the new satellite is available for service is about four months. The second satellite in orbit continues to provide coverage during this four-month period. Of course there is still a probability that the second spacecraft in orbit would fail before the replacement could be launched; however, this probability of failure is much lower than with the scheme now proposed by the Administration.

Question. As a consultant to the World Meteorological Organization (WMO), can you tell us if the WMO has discussed the possibility of other countries, particularly those that utilize satellite data, providing funds for polar-orbiting weather satellites?

Answer. There have been informal discussions within WMO circles regarding ways in which various countries can share in the provision of satellite services. Actually, most countries of the world utilize the satellite data. Up to the present time, there has been a sharing of spacecraft and subsystems among the various countries. The United Kingdom and France each provide a major subsystem on the current series of NOAA polar-orbiting weather satellites. These are provided at no cost to the United States as their contributions to an internationally necessary system. The European countries through the European Space Agency, and Japan each operate a geostationary weather satellite. The USSR is developing a geostationary satellite to cover the Indian Ocean area, and India plans to launch their second INSAT, which includes a meteorological cloud camera, to provide geostationary satellite coverage of the Indian Ocean. These satellites, coupled with the two geostationary (GOES) satellites operated by NOAA, provide cloud coverage around the earth except at high latitudes. Thus, the full international cooperative system of weather satellites now is being provided by a series of coordinated national contributions of hardware and services. International concern over proposed U.S. actions to reduce the reliability of the weather satellites in polar orbit, as well as to transfer all its weather satellites to the private sector, may result in the WMO members considering some form of "internationalized" system whereby they will no longer be vulnerable to unilateral decisions of any one nation.

Question. You mentioned that polar satellites locate and collect data from drifting ocean buoys, balloons, and remote observing stations as well as provide weather data. How important are the data from these remote and mobile stations and the role of the polar satellites to weather forecasting and climate research?

Answer. The use of polar satellites to locate and collect data from drifting platforms is particularly critical in the southern hemisphere and tropical regions where very few observations are now available from land and ship stations. To forecast the weather beyond a few days or to study the climate of planet Earth, complete global coverage is essential.

Question. (a) Would you elaborate on the joint NOAA/NASA program to develop and launch NOAA satellites? (b) Has this been an effective system—or, more precisely, what problems in this program have been encountered in the past?

Answer. The joint DOC(NOAA)—NASA agreement regarding the weather satellite program calls upon NASA to develop and prove the technology needed for operational weather satellites. NASA would fund this development as well as the construction, launch, and test of any new prototype of an operational spacecraft or sensor. Subsequently, NOAA would budget for the cost of follow-on operational spacecraft and launching and the entire cost of operations. NOAA would "contract" with NASA to obtain the operational spacecraft and for their launching according to NOAA specifications. NOAA was responsible for the conduct of the operations, applied research to improve the utilization of satellite data in weather forecasting and other applications, and the processing and use of the satellite data.

This joint effort has been an outstanding success and has worked smoothly until beginning in fiscal year 1982 when a change in NASA priorities and funding took place. At that time, NASA ceased to budget for their portion of the agreement and left it to NOAA to pick up the funding of the development of operational spacecraft and sensors. NASA indicated they would be willing to do the development work provided NOAA would obtain and transfer the necessary funds to NASA. In the current fiscal climate, there is no way in which NOAA could pick up the large increment of funding dropped by NASA. There is also a question in my mind regarding the mission of NASA under the Space Act.

Question. You state that 100 countries receive NOAA satellite data, and that many developing countries rely on these data for regional weather predictions. What would the effect on the nations of the developing world be if the polar-orbiting satellite system were downgraded to a one-satellite system?

Answer. The problem is not with one satellite in orbit but if that one satellite failed prior to the next scheduled launch. And more importantly, if the next launch were to fail there would be a period of more than 18 months with no polar satellite data at all. It is this total absence of data for an unpredicted period of time that would have a major impact on storm warnings and weather predictions throughout the world, but particularly in many developing countries that tend to be located in the tropics or the Southern Hemisphere where very little other weather data are available. These countries, which have become so dependent upon this dramatic

space age contribution of the United States, in most cases would have no recourse to alternate forms of observations.

Senator TRIBLE. Thank you, Dr. Johnson. Dr. Suomi?

Dr. SUOMI. Thank you, Mr. Chairman, for this opportunity to say a few words on the NOAA budget, and again, especially on the impact of the Nation's weather satellite program.

As I say in my testimony, these words are my own, but the general thrust of my testimony reflects the views of the National Academy of Sciences Board on Atmospheric Sciences and Climate. The Board has expressed a willingness to look into the impact of commercialization of the Nation's weather satellite program; however, they have had no information on this subject presented to them so far, so any words to regarding commercialization will be my own.

Some of this is a little repetitious with Dave Johnson, my dear friend who had a copy of my written testimony first.

Well, Mr. Chairman, we find—and now I am speaking for the Academy's views—that the budget is neither realistic nor responsive to the scientific opportunities and the national needs. I will elaborate on this by briefly discussing the program's health, its uniqueness and where the problems are and what might be done about them.

We must first say, as the others who have appeared before us, that there is a very positive side and much of it has come thanks to the success of the global weather experiment which the Congress endorsed some years ago. We can say that both the polar and geostationary weather satellites have made it possible to improve the accuracy and extend the range of weather forecasts of large storms. These results—and they are very impressive—have been obtained thus far in the research mode.

Some of these improvements have already been made in our operational forecasts, but we can expect even greater improvements in the future as these new findings are made operational. However, this is not the time to go into details because in my view, these advances will never be realized if the present budget is put in place.

I could easily talk about this for a long time and describe the contributions both the geostationary and the polar orbiters have made, but Dr. Johnson has already talked about this. I really want to reemphasize the impact of a policy to provide only one polar orbiter instead of the two-satellite system we have employed so successfully. The key issue is that failure of this single polar orbiter would leave us without observations. You have to appreciate that our geostationary satellites cover the United States and a little of the Pacific, some of the Atlantic, but it is the polar orbiter which covers the globe and where we get our data from to make longer range predictions.

We are learning that the weather over Indian ultimately affects us in the United States. You have heard others before me say that things going on in the western Pacific affect the climate and the weather over the United States. So to give up the polar orbiter for a long time would be tragic.

This key element of the global weather system would collapse with catastrophic results. We would have zero soundings coverage